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THESIS

**WOMEN AND NONTRADITIONAL OCCUPATIONS IN THE
NAVY: A STUDY OF QUALIFICATION OVER TIME**

by

Dwayne F. Baxter

September 1993

Thesis Advisor:
Associate Advisor:

Mark J. Eitelberg
Alice M. Crawford

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by

Dwayne F. Baxter
Lieutenant, United States Navy
B.A., Virginia Polytechnic Institute, 1986

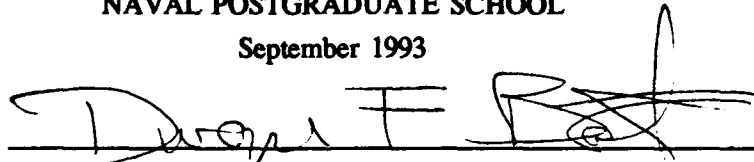
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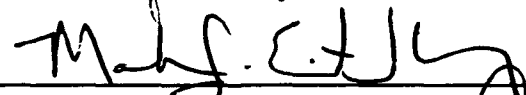
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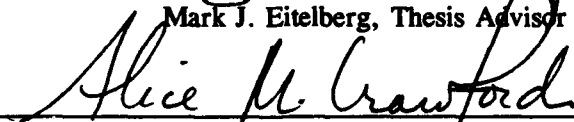
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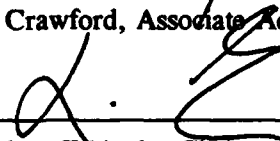
Author:


Dwayne F. Baxter

Approved by:


Mark J. Eitelberg, Thesis Advisor


Alice M. Crawford, Associate Advisor


David R. Whipple, Chairman
Department of Administrative Sciences

ABSTRACT

This thesis examines the qualifications of women for nontraditional ratings over time using the Armed Services Vocational Aptitude Battery (ASVAB). The study focuses on sea-going, nontraditional ratings that are likely to be affected by changes in laws and policies that currently exclude women from combat. Using data from Navy accession files for the years 1981, 1983, 1986, 1989, and 1992, tables were created that compare qualification for four ASVAB composites by various demographic variables, including gender, racial/ethnic group and Recruiting Area. The results indicate that, in general, women who join the Navy qualify at lower rates than men for nontraditional ratings. Further, no improvements have apparently occurred since 1981 in the qualification rates of women for technical, sea-going ratings. To improve the qualification rate of women for nontraditional occupations in the near term, minimum requirements would need to be modified or alternative standards developed. Further research in this area is recommended.

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I. Introduction

A. Background

American women have provided significant and distinguished contributions to the armed forces in times of crisis since the Revolutionary War. Women have also served in the Navy with honor and distinction. The origins of women in the Navy date back to 1908 when the first 20 women were recruited for the newly established Navy Nurse Corps. In World War I, approximately 13,000 women were enlisted as yeomen or "yeomanettes," as they were popularly called, to free men from administrative duties. After the signing of the armistice and the conclusion of the war, these women were discharged from the Navy. In 1942, the entry of the United States into World War II created a large demand for personnel. The manpower shortages that followed prompted the Secretary of the Navy to create the Women Accepted For Voluntary Emergency Service (WAVES); and, once again, over 86,000 American women served in the Navy during a time of crisis. Women's roles in the military have expanded considerably since the end of World War II. Today, women are almost completely integrated into all aspects of the Navy [Thomas, 1978].

Through the first half of this century, the participation of women in the U.S. military was only a temporary measure

that allowed more men to be assigned to combat. In 1948, the Women's Armed Services Integration Act was passed. This law gave women a permanent role in the military, though they were only allowed to be nurses or clerks. This law also restricted the number of enlisted women to 2 percent of the enlisted male population for each service. The opportunities open to women remained in the health care and administrative fields until 1966. In that year, yielding to pressures created by large numbers of women entering the civilian work force and the expanded involvement in the Vietnam conflict, the Department of Defense (DoD) dropped the 2-percent quota and opened more career fields to women.

In the early 1970s, the United States embarked on an unprecedented venture and proceeded to transition the military from a conscripted force of over two-million people to a force comprised completely of volunteers. The All-Volunteer Force (AVF) allowed women to assume an increasingly significant and expanding role in the Navy. This increased role resulted from several factors. First, the diminishing pool of service-eligible and service-interested young men in the general population required the military to search harder for personnel, and women became a visible source of potential labor [Binkin and Bach, 1977]. Also, the military in general and the Navy in particular began to utilize new technology and scientific advances, thus reducing dependence on physical strength. Finally, social forces in the United States, such as

the push for an Equal Rights Amendment and the women's liberation movement, brought the issues of social equity and equal opportunity for women to the forefront of the nation's agenda [Binkin and Bach, 1977].

As a result of the transition to an all-voluntary military as well as various social and political pressures, the opportunities for women in the Navy expanded rapidly throughout the 1970s and early 1980s. A time line for some of these increased opportunities is presented in Table 1.

In the last few years, women have made great gains toward full assimilation into all aspects of the military. Over 40,000 women served in Operations Desert Shield and Desert Storm, including 4,449 Navy women.¹ Today, female Naval officers command aviation squadrons and ships at sea while enlisted women serve in all but 14 of the Navy's 124 ratings or occupations. These 14 restricted ratings involve skills that are performed principally on combatant vessels. Currently, U.S. law prevents women from serving on combatant ships. Title 10, Section 6015 of the U.S. Code of Federal Regulations states that:

¹ Mark J. Eitelberg, "Population Representation in Operation Desert Shield and Desert Storm: A Preliminary Assessment", Appendix D in Department of Defense, Population Representation in the Military Services, Fiscal Year 1990, Washington, D.C., Office of the Assistant Secretary of Defense (Force Management and Personnel), July 1991.

TABLE 1.
A CHRONOLOGY OF WOMEN'S PROGRESS IN THE NAVY
AND OTHER SERVICES FORM 1972 TO PRESENT

- 1972- The percentage of women in the active-duty military increases from 1.9 to 5 percent.
- The director of the Navy Nurse Corps becomes the first woman promoted to Rear Admiral.
 - Women now eligible to command shore activities.
 - Pilot program on USS Sanctuary (AH 17) evaluates women at sea.
- 1973- Women start flight training.
- Pregnancy no longer means automatic discharge.
- 1975- Women allowed to enter military academies.
- 1976- First woman unrestricted line Rear Admiral.
- 1978- Congress amends law, women now allowed to serve on some Navy ships.
- 1979- First female aviator qualifies for carrier landings.
- First woman qualifies as surface warfare officer.
- 1987- Combat logistics force ships opened to women.
- 1988- First woman selected for command at sea
- First woman selected for command of aviation squadron.
- 1989- First woman selected as at-sea command master chief.
- 1991- Over 35,000 women serve in Operations Desert Shield and Desert Storm.
- Congress authorizes the services to allow women into Combat Aircraft.
- 1992- Presidential Commission of the Assignment of Women in the Armed Forces recommends women be assigned to combatant ships.
- 1993- Secretary of Defense orders services to allow women into combat aircraft and asks for legislation to allow women to serve on most combatant ships.

Women may not be assigned to duty on vessels that are engaged in combat missions (other than as aviation officers as part of an air wing or other air element assigned to such a vessel) nor may they be assigned to other than temporary duty on other vessels of the Navy except hospital ships, transports and vessels of similar classification not expected to be assigned combat missions.

After Desert Storm, Congress removed the legal restrictions imposed on women in combat aircraft, but left the final decision on whether to assign women to combat aircraft up to the individual services.

The success of the women who served in Operation Desert Storm and the significant role military women have played in other recent crises have raised questions about the equity of continuing restrictions that prevent women from serving in all aspects of the Navy, including combat. Public and Congressional interest in the issue following Operation Desert Storm led to the creation of a commission to examine whether current laws and policies should be changed. In 1992, the Presidential Commission on the Assignment of Women in the Armed Forces released its final report. The Commission advised against broadening the role of women in air and ground combat, but it recommended that women should be allowed to serve on combatant ships.

Announcements by the Office of the Secretary of Defense (OSD) and Chief of Naval Operations (CNO) in 1993 called for women to be put in all front-line combat jobs by 1997. With these expected changes, there is a great deal of interest in

the supply of women who may be qualified and interested in serving in combat-related occupations. These occupations are frequently called "nontraditional."² Before changes to federal laws and military service policies occur, the percentages of women in the Navy who are eligible to get training for these newly-opened, nontraditional ratings should be determined.

B. Objectives Of Study

This thesis explores the eligibility of women to be selected for training in the Navy's nontraditional occupations based on the current standards used to screen applicants. In addition, the study examines trends in the expected eligibility among women who have enlisted in the Navy over an eleven-year period. It is anticipated that this information can provide insight into the general availability of qualified women who may be interested in Naval service in the years ahead, as well as suggest possible changes that have occurred over time in the aptitudes of women who joined the Navy. This study draws on data resources from the Navy's active-duty accession files and uses scores from the Armed Services

² The phrase, "nontraditional," as it is used in this study refers to jobs that women have been restricted from occupying as well as those that have not traditionally been occupied by women in the past and are deemed "nontraditionally female" (as opposed to jobs in the Navy that have not traditionally been held by men, such as Dental Technicians or Nurses).

Vocational Aptitude Battery (ASVAB), which all recruits are required to take.

C. Organization Of The Study

This study is organized into five chapters. The next chapter reviews pertinent studies and other literature that relate to the eligibility of women for nontraditional jobs in the Navy. Chapter III describes the contents of the data files that are utilized as well as the research methodology. Chapter IV presents the results of the study, and Chapter V summarizes the conclusions drawn from the findings. Also provided are recommendations derived from the research effort and suggestions for further research.

II. Background and Literature Review

This chapter reviews literature related to the eligibility of women for the Navy's nontraditional jobs. The first section looks at previous research on the history of women's service in nontraditional or combat jobs. The second section examines how eligibility for jobs in the Navy is determined. This section also describes the Armed Services Vocational Aptitude Battery or ASVAB and the portions of the test used by the Navy to place recruits into occupations. The third section briefly reviews research that compares the performance of men and women on aptitude tests. The final section looks at literature on the qualification of women for nontraditional jobs in the Navy and existing information on female participation in these jobs.

A. Historical Perspective

The debate over whether or how women should be utilized in the military can be traced back to the earliest writings of Western civilization. For example, Plato discussed the role of women during war in his dialogue, Republic, written in the 4th Century B.C. In that work, Plato wrote that women "must have the same two branches of training for mind and body [as men] and also be taught the art of war, and they must receive the

same treatment."³ Plato also wrote that, when the State goes to battle, "men and women will take the field together."⁴ In the two millennia that have followed, the question of what role women should play within the military remains basically unresolved in many Western democratic nations. Several modern authors have explored the theoretical, social, and practical issues regarding the military service of women. Modern writings also cover the historical contributions of women during war and frequently present various prescriptions and speculations for the future.

There are several excellent books and studies that offer insight into issues facing policy makers and service members as women continue to play a larger role in America's modern, all-volunteer military. A good example of such work is Women in the Military: An Unfinished Revolution (1984) by Major General Jeanne Holm, USAF (Ret). General Holm was, at the time of her retirement, the highest-ranking woman ever to serve in the U.S. armed forces. In her book, she provides an extensive account of the history of women in the United States military, starting with Molly Pitcher and ending with the role of women in today's force. Throughout the story, she relates her

³ Mark Eitelberg, "Your Mother Wears Combat Boots ... But Should She Pack A Gun?", paper presented at the Annual Meeting of the American Psychological Association, Boston, MA, August 1990.

⁴ Ibid.

personal experiences, a result of her thirty-three-year career, to the issues facing military women and the need for military leadership to cope with change.

Other works that explore the history of women in the military are Judith Stiehm's Arms and the Enlisted Woman (1989) and Patricia Thomas's "From Yeomanettes to WAVES to Women in the U.S. Navy" (1986). Stiehm examines the evolution of policies toward enlisted women and the influences that have caused changes in those policies. While she does examine the history of women in the military, Stiehm concentrates on how public attitudes, as well as the opinions of Congressional and military leaders, have operated to change the role of women in the military since World War II. On the other hand, Thomas discusses how changes in policy and opinion have affected the motivation and attitudes of Navy women through history, and she describes the difficulties that women have encountered while functioning in the Navy environment.

In addition to historical accounts, there are several excellent studies on how the changing social attitudes of the nation and changing national security concerns have affected the expansion of female participation in the military. For example, in Women in the Military (1977), Martin Binkin and Shirley J. Bach evaluate restrictions that deny women access to jobs in the military. The authors point out that, when a group is barred from participating in the major function of an organization, its members are generally viewed as "second-

class" members within the organization. In addition, Binkin and Bach argue that restrictions on female participation also deny the nation a competent pool of workers who might be willing to volunteer. In their groundbreaking work, Binkin and Bach outline what can be done within the present (1977) framework to expand the role of women in the military, while also explaining the possibly adverse consequences of removing all barriers.

Many studies and books that examine the history of women in the U.S. military appear to support the expanded use of women in combat-related fields. However, there are more than a few published works that take the opposite position. One such publication is Brian Mitchell's controversial book, Weak Link: The Feminization of the American Military (1989). In this work, Mitchell argues that women have fundamental physical and psychological attributes that differ from those of men, making it unlikely that women can ever perform as well as men in the military. Mitchell also speculates that the military's leaders recognize the inherent weaknesses of women, but that they are fearful of speaking out because of pressure from feminists in and out of government. Critics of Mitchell's work have observed that his arguments are often unsupported and that his position fails to take account of the many contributions military women have made. For example, several other writers have concluded that the increasing number of women in the American military during the mid-1970s allowed

the all-volunteer system of recruiting to succeed. Without women acting as "substitutes" for men, the military would probably not have had enough highly-qualified people to fill required billets, and the nation might have been forced to revive some form of conscription⁵.

One common theme that seems to run throughout most of the literature is that women have provided significant contributions to the country when they have been allowed to serve in the military. The expanded role of women in the military has resulted largely from public and political pressure for women's rights. Change has come slowly and in increments over time. However, once women are given an opportunity to prove themselves in an area, new norms are established, the stakes are raised, further changes are considered, and the system continues to move in the direction of removing all barriers.

B. Evolution of Selection Standards

The U.S. military has been a trailblazer in field of personnel testing and selection. The military's fundamental purpose for using selection criteria is to eliminate "bad risks" and those who cannot meet the "severe demands of war" as well as to select people who can be trained most

⁵ For example, see Mark J. Eitelberg, "Your Mother Wears Combat Boots ... But Should She Pack A Gun?".

effectively and efficiently.⁶ Screening for Service (1984) by Eitelberg et al. provides an excellent historical review of the evolution of military personnel testing and selection. In addition to explaining how military selection standards have evolved, the work also discusses trends in the military's screening of recruits. The authors emphasize that selection standards are flexible and they can change rapidly as the personnel needs of the armed forces increase or decline.

The issue of selecting eligible men for military service was first raised in World War I. The weapons used in the war were more sophisticated and lethal than in previous conflicts. Because of this, a requirement for screening techniques emerged to ensure that soldiers could accomplish their tasks. The Army Alpha and Army Beta tests were subsequently developed to provide military commanders with an index of the learning abilities of their men. At the same time, these tests were designed to give manpower and personnel planners an objective base to make personnel assignments by separating slow and fast learners into different categories.⁷

After World War I, the purpose of the military's screening of candidates shifted from preparing men for war to limiting

⁶ Mark J. Eitelberg, Janice H. Laurence, and Brian K. Waters; with Linda S. Perelman (1984), Screening for Service: Aptitude and Education Criteria for Military Entry Washington, D.C., Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics), p. 7.

⁷ Department of the Army, (1965), Marginal Man and Military Service, Washington D.C., Department of the Army, p. 53.

the number of potential pensioners. During the post-war period, the military was concerned that unfit men might enter the military and then later be discharged for an injury received supposedly while on active duty, thus gaining a pension through subterfuge.

During World War II, the Army General Classification Test (AGCT) was developed to take the place of the Army Alpha test and was used to determine general learning ability. The AGCT also separated soldiers into five Grades (I-V). The test was standardized to ensure that scores were representative of the age, education, and geographic distributions in the civilian manpower pool. The rapid learners (those who scored above 130) were placed in grade I, while slow learners (those who had a score below 69) were placed in grade V.⁸ The military has always had members who range the entire spectrum of learning abilities, including those who are relatively slow learners. One report that describes how the Army has utilized men who have been classified as "marginal" is Marginal Man and Military Service. This 1965 study by the Department of the Army examines the military's programs for utilizing so-called "marginal" men. The study points out that everyone is marginal, at least in some area, and that "marginality is a

⁸ Eitelberg et al., Screening for Service, p.15

relative concept which can be meaningful only in a defined context"⁹.

After World War II, the Departments of the Army, Air Force, and Navy, jointly developed a test that was used to screen enlisted personnel. The Armed Forces Qualification Test (AFQT) was introduced in 1950; and, although it has been modified over time, the AFQT remains in use today. In the years following World War II, each service employed its own test to place recruits into training for an occupation. In the mid-1970s the Department of Defense introduced the Armed Services Vocational Aptitude Battery as a service-wide instrument for selecting and classifying all military recruits.

C. Description of ASVAB and Composites

The ASVAB has been used by all Services to screen military applicants since January 1976, when Forms 6 and 7 were introduced. In 1980, these versions were replaced by Forms 8, 9 and 10. New versions of the ASVAB are developed periodically to prevent the examination from being compromised. As of 1992, the Services were using Forms 18 and 19.¹⁰

⁹ Department of the Army, Marginal Man and Military Service, p. 1. It should be noted that restrictions barring the service of women in combat-related occupations places them in the category of "marginal" personnel by this definition.

¹⁰ U.S. Department of Defense. (1992). ASVAB 18/19 Counselor Manual. North Chicago, IL: U.S. Military Entrance Processing Command. Chap 7.

The ASVAB consists of ten subtests that are designed to examine a recruit's abilities in areas considered important to military jobs. It currently tests skills in the following areas: Word Knowledge, Paragraph Comprehension, Arithmetic Reasoning, Numerical Operations, Coding Speed, General Science, Mathematics Knowledge, Mechanical Comprehension, Electronics Information, and Auto Shop Information. The first four tests listed above measure general trainability, and the second six measure more specialized knowledge considered relevant to technical vocations.¹¹ The subtests are grouped together in different combinations, called composites. These composites are used to establish the minimum requirements for entry into the military and qualification for training in a specific occupation or rating. Table 2 lists the ten ASVAB subtests along with a brief description of the knowledge or ability tested, the number of questions, and the testing time. Using the ASVAB as a base, each service assembles composites to measure aptitudes in skills that are related to a particular occupation. The choice of subtests used to create a composite is based on the ability of the subtests to predict performance in a group of occupations. A report by the Defense Manpower Commission (1976) describes the basic principle applied here:

¹¹ Darrell R. Bock and Elsie G. Moore, Profile of American Youth: Demographic Influences on ASVAB Test Performance, Chicago, IL, Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics), 1984, p. 5.

Eligibility for assignment to jobs involving, for instance, mechanical work was determined by the score a person achieved on a test purportedly predictive of mechanical aptitude. Thus the qualification of individuals for assignments to all occupations in which mechanical work predominated was governed by the score attained on the mechanical aptitude test. Similarly, other occupations characterized by another common aptitude required. This practice continues today, although the various aptitude tests have been periodically refined over the years.¹²

The Armed Forces Qualification Test, or AFQT, is an ASVAB composite currently used by all Services in enlistment screening. The AFQT is used to predict an applicant's overall "trainability." It consists of the Word Knowledge, Paragraph Comprehension, Mathematics Knowledge, and Arithmetic Reasoning subtests. The Word Knowledge and Paragraph Comprehension subtests are frequently combined to form the Verbal (or VE) composite. Also, the Verbal composite subtest score is counted twice while the other subtests are counted once. Prior to 1989, another composite made up the AFQT. The previous composite used in calculating the AFQT score consisted of the Verbal, Arithmetic Reasoning, and Numerical Operations subtests. In the previous AFQT, the Numerical Operations score was counted as one-half, while the other subtests were counted once. The AFQT was changed because the Numerical Operations

¹² Mark J. Eitelberg, Manpower for Military Occupations Washington, D.C.: Office of the Assistant Secretary of Defense (Force Management and Personnel), 1988, p. 69.

TABLE 2.
ARMED FORCES VOCATIONAL APTITUDE BATTERY (ASVAB)
SUBTESTS: DESCRIPTION, NUMBER OF QUESTIONS, AND TESTING TIME

ASVAB Subtest Title and Abbreviation	Description	Number of Questions	Time (min)
General Science (GS)	Measures knowledge of physical and biological sciences	25	11
Arithmetic Reasoning (AR)	Measures Ability to solve arithmetic word problems	30	36
Word Knowledge (WK)	Measures ability to	35	11
Paragraph Comprehension (PC)	Measures ability to obtain information from written passages	15	13
Numerical Operations (NO)	Measures ability to perform arithmetic computations in a speeded context	50	3
Coding Speed (CS)	Measures ability to use a key in assigning code numbers to words in a speeded context	84	7
Auto and Shop Information (AS)	Measures Knowledge of automobiles, tools, and shops terminology	25	11
Mathematics Knowledge (MK)	Measures knowledge of high school mathematics principles	25	24
Mechanical Comprehension (MC)	Measures Knowledge of mechanical and physical principles and ability to visualize how illustrated objects work	25	19
Electronics (EI)	Measures knowledge of electricity and electronics	20	9

All Subtests

344

144

SOURCE: Derived From Data Provided by the Navy Personnel Research and Development Center (NPRDC).

subtest is not as predictive of successful trainability as are the verbal skills and general mathematics subtests. Table 3 shows the ASVAB composites (and their component subtests) used by the Navy.

TABLE 3.
ASVAB COMPOSITES AND COMPONENT SUBTESTS

ASVAB Composite	Component Subtest
New AFQT*	2VE + AR + MK
Old AFQT*	WK + PC + AR + NO/2
Electronic (EL)	AR + MK + EI + GS
Basic Electricity/Electronics (BE/E)	AR + GS + 2MK
Clerical (CL)	NO + CS + VE
General Technical (GT)	VE + AR
Mechanical (ME)	VE + MC + AS
Basic Engineering (EG)	MK + AS
Communications Technician (CT)	VE + AR + NO + CS
Hospitalman (HM)	VE + MK + GS
Submarine (ST)	VE + AR + MC
Machinery Repairman (MR)	AR + MC + AS

SOURCE: Derived from data provided by Defense Manpower Data Center.

* Old AFQT Scores are the sum of raw subtest scores versus new AFQT score which are the sum of subtest standard scores. New AFQT is used after 1 Jan 89.

AFQT scores are divided into five categories for administrative and reporting purposes. Persons who score in AFQT Categories I and II are considered "above average" in trainability; those who score in Category III are "average"; those in Category IV are "below average"; and persons scoring in Category V are considered "well below average" in trainability and legally barred from military service. Table 4 shows the percentile scores for each AFQT Category.

The Services may increase their minimum AFQT standards to reduce the eligible pool of recruits and concentrate recruiting efforts on those with higher test scores. For example, during a good recruiting year, the Services may find that the pool of applicants in the above-average range is large enough so that standards can be tightened for applicants scoring at lower levels, perhaps restricting admission to high school graduates who score in the "average" and above levels¹³.

As previously noted, each Service uses its own composites for assigning personnel to occupational training. The Services also choose the minimum acceptable score that will allow a person to qualify for training in a particular occupation. This minimum score is commonly called the "cut score."

¹³ Eitelberg Mark J, Screening for Service, p. 16.

TABLE 4.
ARMED FORCES QUALIFICATION TEST (AFQT)
CATEGORIES AND CORRESPONDING PERCENTILE SCORE RANGE

AFQT Category	Percentile Score Range
I	93-100
II	65-92
III	31-64
IV	10-30
V	1-9

SOURCE: Derived from data provided by Defense Manpower Data Center.

Previous studies have noted there are differences in the scores of men and women on the ASVAB¹⁴. These differences have raised questions about the fairness of the test and, more generally, about fundamental disparities in the abilities of men and women.

Are women inherently less qualified than men for technical or combat-related jobs in the Navy? Or is the ASVAB somehow biased?

D. Bias in Testing and the ASVAB

A number of studies have examined gender-related differences that occur in mental testing. Some of these efforts have specifically addressed the fairness of the military's enlistment test. This section reviews some of these

¹⁴ See, M. Binkin, and Mark J. Eitelberg, "Women and Minorities in the all-volunteer force." In Bowman, W., Little, R., and Sicilia, G.T. (Eds.). The All Volunteer Force After A Decade: Retrospect and Prospect. Elmsford, NY: Pergamon-Brassey's, 1986, p. 73.

studies and examines what those differences are in addressing the question of whether the ASVAB provides an accurate measure of persons who should be placed in occupations.

One of the most comprehensive studies to examine the correlation between individual differences and ASVAB scores is Demographic Influences on ASVAB Test Performance by Darrell Bock and Elsie Moore. This 1984 study reports the results of the 1980 "Profile of American Youth" in which the ASVAB was administered to a representative sample of 12,000 young people between the ages of 16 and 23. The Profile study was undertaken in part to establish new national norms for the ASVAB. The study by Bock and Moore found that women are at a competitive disadvantage relative to men in tests "requiring technical knowledge and quantitative skills"; and "they have an advantage in tests requiring fluent and accurate information processing and use of knowledge."¹⁵ The study attributed many of the male-female differences to "sexual specification of education," but noted that some results may be traced to "biologically intrinsic differences."¹⁶

Other studies, such as Mark Eitelberg's Subpopulation Differences in Performance on Tests of Mental Ability (1981) and Gita Wilder's Sex Differences in Test Performance (1989), provide an in-depth review of the history and research concerning these differences. Both of these authors agree

¹⁵ Darrell R. Bock, and Elsie G. Moore, Profile of American Youth: Demographic Influences in ASVAB Test Performance, p. 275.

¹⁶ Ibid, p. 275

that, historically, men have tended to excel in quantitative skills while women have shown an advantage in verbal skills. The opinions of researchers vary widely in trying to explain why these differences occur. On one end of the spectrum are the writings of Arthur Jensen, author of Bias in Mental Testing (1980). His work promotes the "nature" side of the "nature versus nurture" debate with respect to individual differences and cognitive abilities. Jensen's controversial work promotes the hypothesis that certain differences in mental ability exist between men and women because of inherent, genetically-tied reasons.

A more specific study of gender differences on the ASVAB can be found in a report by the Department of Defense, entitled Sensitivity and Fairness of the Armed Services Vocational Aptitude Battery (ASVAB) Technical Composites (1992). This report was released in response to questions raised by the General Accounting Office (GAO) in Military Training: Its Effectiveness for Technical Specialties is Unknown (1990). The GAO report stated that the ASVAB was a relatively poor predictor of success in training by minorities and women. The report compared the qualification rates of women with those of men for various ASVAB composites, including Electronics and Mechanical; and it then compared test scores to graduation results from selected technical training courses in the armed forces. The Defense Department report concluded that, although differences between the sexes exist, they are small; and, contrary to the GAO finding, ASVAB

technical composites are actually more sensitive predictors of success for women than for men¹⁷.

A comprehensive analysis of qualification differences between men and women can be found in Manpower for Military Occupations by Mark Eitelberg. The study used data from the 1980 "Profile of American Youth." As previously noted, the Profile results were used to establish new national norms for the ASVAB. Table 23 of Eitelberg's work compares the scores of men and women (18-23 years old) on the 10 ASVAB subtests¹⁸. This table is reproduced in Table 5. As seen here, the six tests that tend to "favor" men make up the majority of the composites used to select sailors for training in nontraditionally-female or combat-related ratings.

The question of gender-bias on the ASVAB is still a contentious issue, though the Department of Defense has taken steps to insure that the test is fair in as many ways as possible to persons in different demographic groups. However, the ASVAB is a "vocational aptitude" battery; and the vocations that it covers are those in which men have traditionally worked. Indeed, these are the jobs one would expect to prevail in an armed force where the primary mission involves combat. The

¹⁷ Department of Defense, Defense Manpower Data Center, Technical Report (1992), "Sensitivity and Fairness of the Armed Services Vocational Aptitude Battery (ASVAB) Technical Composites", Report # 92-002, p. 18.

¹⁸ Mark J. Eitelberg, Manpower for Military Occupations, p. 95.

issue, then, is not whether these specific subtests or composites are necessarily biased in one way or another for or against women, but whether alternative criteria exist that can be as effective in predicting occupational training success without the wide differences in gender-related performance.

The next section examines some of the literature on the possible reasons why women choose nontraditional occupations.

TABLE 5.
COMPARATIVE MEANS OF PERCENTILE SCORES OF MEN AND WOMEN
18-23 YEARS OF AGE ON THE ARMED SERVICES VOCATIONAL
APTITUDE BATTERY (ASVAB) SUBTESTS

ASVAB Subtest	Mean for Men	Mean for Women
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Performance Difference Favors Men

General Science	51.3	47.9
Arithmetic Reasoning	51.7	48.9
Auto and Shop Information	51.4	40.9
Mathematics Knowledge	52.6	51.1
Mechanical Comprehension	51.2	43.9
Electronics Information	51.5	44.3

Performance Difference Favors Women

Paragraph Comprehension	50.6	52.4
Numerical Operations	47.6	49.6
Coding Speed	49.9	54.1

No Sex-Related Performance Difference

Word Knowledge	50.8	50.9
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Source: Adapted from Table 23 in Eitelberg, Manpower for Military Occupations, 1988, p. 95.

E. Participation of Women in Nontraditional Jobs

Literature on the ability of women to qualify for nontraditional occupations is scant, especially with respect to jobs within the military. However, literature does exist on the propensity of women to choose nontraditional careers. A good example is a report by John Waite and Susan Berryman entitled Women in Nontraditional Occupations (1985). The stated purpose of the authors in this work is to identify the factors that cause women to choose and remain in "sex-atypical" jobs. The authors found that the nontraditional nature of a job has no effect on job turnover for women. Job satisfaction, on the other hand, exercised a strong influence on whether a women remained in or left a nontraditional job. Another study that specifically examined why women choose to enlist in the military is Serving Her Country: An Analysis of Women's Enlistment (1990) by James Hosek and Christine Peterson. This study, like that of Waite and Berryman, found that the nontraditionality of a job has little impact on a woman's choice to enlist. In fact, Hosek and Peterson conclude that the reasons given by women for enlisting in the military are not significantly different from those of men.

These and related studies suggest that women do not generally shy away from occupations just because they are "nontraditional." However, women may have different values and perceptions of what constitutes job satisfaction.¹⁹ When a

¹⁹ Martin Binkin and Shirley Bach (1977), Women and the Military, Washington, D.C., The Brookings Institution, p. 80.

potentially satisfying job is available, women can be expected to behave just as men would behave; and, thus as previously restricted jobs are opened to women, their interest in applying for those positions will hinge largely on perceptions of the job itself.²⁰

²⁰ Marshal B. Brown, An Analysis of the Propensity for Nontraditional Occupations Among Civilian and Navy Women, Master's Thesis, Naval Postgraduate School, Monterey, CA, September 1993.

III. Methodology

The primary purpose of this thesis is to examine the qualification rates of women for the Navy's nontraditional occupations over time. This chapter explains why the Electronics, Basic Electronics and Electricity, Mechanical and Machinery Repairman composites were selected, and describes the data and methods employed in the study. A description of the data sources is presented below. This is followed by an examination of the accession files for the years 1981, 1983, 1986, 1989 and 1992.

A. Choice of Navy Composites

Four ASVAB composites are examined in this thesis. They are: Electronics, Basic Electricity/Electronics, Mechanical, and Machinery Repairman. There are several reasons why these composites were selected for examination. The first reason relates to the recent announcement by the Chief of Naval Personnel that the Navy will become "gender-neutral" in the near future.²¹ To accomplish this, the 14 ratings currently restricted to women would have to be opened up. Most of these restricted occupations are performed on combatant ships and involve working with electronic equipment. Thirteen of these restricted ratings use the Electronics composite to determine eligibility for training. The remaining restricted rating uses

²¹ Patrick Pexton, "A Gender-Neutral Navy in 5 Years," Navy Times, April 26 1993, p. 4.

the Basic Electronics and Electricity composite to determine training eligibility.²²

The reason the Mechanical and Machinery Repairman composites were chosen is a result of conversations with Mrs. Patricia Thomas. Mrs. Thomas is the Director of the Women and Multicultural Research Office at the Navy Personnel Research and Development Center (NPRDC) in San Diego, California. Her office is conducting research into the qualification of applicants for different occupations in the Navy. Two of the composites she is examining are Mechanical and Machinery Repairman. Her preliminary findings indicate that women score much lower than men on the Auto Shop subtest of the ASVAR. This finding is consistent with previous research into this subject.²³ The final reason these composites were chosen is that they cover 49 ratings,²⁴ all of which are sea-intensive and considered "nontraditional" for women.

B. Data Sources

The data for this thesis were provided by the Defense Manpower Data Center (DMDC) in Monterey, California. The data set consists of the Navy personnel accession files for the

²² Bureau of Naval Personnel (August 1992), Enlisted Transfer Manual (NAVPERS 15909E), Washington, D.C., Chap 7.

²³ See, M. Binkin, and Mark J. Eitelberg, "Women and Minorities in the all-volunteer force." In Bowman, W., Little, R., and Sicilia, G.T. (Eds.), The All Volunteer Force After A Decade: Retrospect and Prospect.

²⁴ Bureau of Naval Personnel, Enlisted Transfer Manual, Chap 7.

years 1981, 1983, 1986, 1989, and 1992. It includes the following demographic variables: sex, race, age, and education. The values for the demographic variables are listed in Table 6. These categories are, for the most part, self-evident, with the exception of the age variable. The category 17-21 years was selected because it is considered the primary age group in recruiting for the military. The category 22-35 years was selected because, under current Navy policy, the age limit for a new recruit is 35 years old. The data files also include AFQT percentile scores of recruits along with the ten composite scores used by the Navy. The data were provided by DMDC in raw form. The author wrote a SAS program to read and manipulate the data. After this was completed, the "cut scores," provided by the NPRDC, were coded into the program. This allowed estimates of the number of recruits eligible for the occupations covered by the composites. Then, various SAS procedures were utilized to create statistical data tables sorted by the various demographic variables. Harvard Graphics software was used to make graphs of the data so that trends and ratios could be described. A list of the four composites examined in this study, along with their "cut scores," is presented in Table 7.

TABLE 6.
DESCRIPTION OF DEMOGRAPHIC VARIABLES

Sex	Race/ Ethnicity	Age (Years)	Education
Male	White	17-21	High School Graduate
Female	Black	22-35	GED or Other Equivalency Certificate
	Hispanic		Non High School Graduate
	Other		

TABLE 7.
DESCRIPTION OF ASVAB COMPOSITES AND CUT SCORES

Composite	Component Subtests and Cut Scores*
Electronics	AR + MK + EI + GS = 218
Basic Electronics and Electricity	AR + GS + 2MK = 196
Mechanical	VE + MC + AS = 158
Machinery Repairman	AR + MC + AS = 158

* NOTE: Abbreviations for subtests are explained in table 2 above. Cut scores are expressed as the sum of the subtest standard scores.

C. Year-Group 1981

The original intent of this thesis was to examine trends in the eligibility of female sailors for nontraditional Navy ratings over a twelve-year period starting with 1980. However, the aptitude composites that are used today were not available to DMDC until 1981. Therefore, the accession file for the year 1981 is used as the start date. The original population for this year-group was 84,757, but there were missing entries for several of the variables. After

subtracting the 31,431 missing entries, a population of 53,326 remains. A visual examination of the raw data file indicated that the missing entries in this year-group occurred randomly. The large number of missing entries for this year-group can most likely be attributed to the fact that personnel who enlisted under the Delayed Entry Program (DEP) actually took the test in 1980, prior to the establishment of these composites in DMDC's files; therefore, the scores of these people are not in the accession file. A description of the demographic variables for this year-group is presented in Table 8. Table 9 provides a description of the composite test scores and the AFQT percentile scores for this year-group.

TABLE 8.
DESCRIPTION OF DEMOGRAPHIC VARIABLES FOR YEAR-GROUP 1981

Variable	Category	Number	Percentage of Population
Sex	Male	48,528	91.0
	Female	4,798	9.0
Race/ Ethnicity	White	43,071	80.8
	Black	6,888	12.9
	Hispanic	2,035	3.8
	Other	1,332	2.5
Age	17-21	44,754	83.9
	22-35	8,572	16.1
Education	High School Graduate	38,890	72.9
	GED or Equivalent	7,100	13.3
	Non-High School Graduate	7,336	13.8

TABLE 9.
DESCRIPTION OF COMPOSITE SCORES FOR YEAR-GROUP 1981

Composite	Mean Score	Standard Deviation
Electronics	209.8	25.4
B/EE	206.7	27.3
Mechanical	161.0	19.1
Machinery Repairman	162.5	20.1
AFQT Percentile	55.2	21.4

D. Year-Group 1983

The original population of this year-group included 73,343 recruits. However, there were missing entries in this file. After removing the 8,926 missing entries, a final population of 64,417 remains. A visual examination of the raw data file was conducted to verify that the missing entries are random and appear to have occurred as the result of entry or record-keeping errors. Table 10 provides a description of the demographic variables for this year-group.

TABLE 10.
DESCRIPTION OF DEMOGRAPHIC VARIABLES FOR YEAR GROUP 1983

Variable	Category	Number	Percentage of Population
Sex	Male	56,803	88.2
	Female	7,614	11.8
Race/ Ethnicity	White	50,737	78.8
	Black	9,208	14.3
	Hispanic	2,861	4.4
	Other	1,611	2.5
AGE	17-21 Yrs	50,953	79.1
	22-35 Yrs	13,464	20.9
Education	High School Graduate	58,196	90.3
	GED or Equivalent	3,428	5.3
	Non-High School Graduate	2,793	4.3

Table 11 shows the composite scores and AFQT percentile scores for year-group 1983.

TABLE 11.
DESCRIPTION OF COMPOSITE SCORES FOR YEAR-GROUP 1983

Composite	Mean Score	Standard Deviation
Electronics	213.5	25.6
B/EE	211.9	27.6
Mechanical	162.4	19.2
Machinery Repairman	164.2	20.4
AFQT Percentile	58.8	21.6

E. Year-Group 1986

The original population of this year-group totaled 88,058 recruits. However, there were missing entries in this file. After removing the 1,720 missing entries, a final population of 86,338 remains. A visual examination of the raw data file was conducted to verify that the missing entries are random and appear to have occurred as the result of entry or record-keeping errors. Table 12 provides a description of the demographic variables for this year-group. Table 13 shows the composite scores and AFQT percentile scores for year-group 1986.

TABLE 12.
DESCRIPTION OF DEMOGRAPHIC VARIABLES FOR YEAR-GROUP 1986

Variable	Category	Number	Percentage of Population
Sex	Male	77,718	90.0
	Female	8,620	10.0
Race/ Ethnicity	White	63,528	73.6
	Black	15,045	17.4
	Hispanic	5,018	5.8
	Other	2,747	3.2
AGE	17-21 Yrs	75,103	87.0
	22-35 Yrs	11,235	13.0
Education	High School Graduate	73,757	85.4
	GED or Equivalent	5,685	6.6
	Non-High School Graduate	6,896	8.0

TABLE 13.
DESCRIPTION OF COMPOSITE SCORES FOR YEAR-GROUP 1986

Composite	Mean Score	Standard Deviation
Electronics	208.1	25.8
B/EE	207.2	27.3
Mechanical	159.9	19.2
Machinery Repairman	159.4	20.5
AFQT Percentile	56.4	20.2

F. Year-Group 1989

The original population of this year-group included 88,151 men and women. However, there were missing entries in this file. After removing the 2,542 missing entries, a final population of 85,609 remains. A visual inspection of the raw data file was conducted to verify the missing entries are random and appear to have occurred as the result of entry or record-keeping errors. Table 14 provides a description of the demographic variables for this year-group.

TABLE 14.
DESCRIPTION OF DEMOGRAPHIC VARIABLES FOR YEAR-GROUP 1989

Variable	Category	Number	Percentage of Population
Sex	Male	75,392	88.1
	Female	10,217	11.9
Race/ Ethnicity	White	57,705	67.4
	Black	18,339	21.4
	Hispanic	6,814	8.0
	Other	2,751	3.2
AGE	17-21 Yrs	73,194	85.5
	22-35 Yrs	12,412	14.5
Education	High School Graduate	74,612	87.2
	GED or Equivalent	6,277	7.3
	Non-High School Graduate	4,720	5.5

Table 15 shows the composite scores and AFQT percentile scores for year-group 1989.

TABLE 15.
DESCRIPTION OF COMPOSITE SCORES FOR YEAR-GROUP 1989

Composite	Mean Score	Standard Deviation
Electronics	206.9	25.5
B/EE	208.1	27.0
Mechanical	157.0	19.1
Machinery Repairman	156.4	20.7
AFQT Percentile	55.8	20.4

G. Year-Group 1992

The original population of this year-group numbered 57,562. However, there were missing entries in this file. After removing the 256 missing entries, a final population of 57,306 remains. The fact that there were so few missing entries plus a visual inspection of the raw data file indicates they occurred randomly as the result of entry or record-keeping errors. This year-group is significantly smaller than in previous years because of the reduction-in-force and the Defense-wide "downsizing." Table 16 provides a description of the demographic variables for this year-group. Table 17 shows the composite scores and AFQT percentile scores for year-group 1992.

TABLE 16.
DESCRIPTION OF DEMOGRAPHIC VARIABLES FOR YEAR-GROUP 1992

Variable	Category	Number	Percentage of Population
Sex	Male	49,210	85.9
	Female	8,096	14.1
Race/ Ethnicity	White	39,597	69.1
	Black	9,601	16.8
	Hispanic	6,091	10.6
	Other	2,017	3.5
AGE	17-21 Yrs	48,403	84.5
	22-35 Yrs	8,903	15.5
Education	High School Graduate	54,971	95.9
	GED or Equivalent	2,053	3.6
	Non-High School Graduate	282	0.5

TABLE 17.
DESCRIPTION OF COMPOSITE SCORES FOR YEAR-GROUP 1992

Composite	Mean Score	Standard Deviation
Electronics	211.9	23.7
B/EE	215.5	25.2
Mechanical	158.5	17.4
Machinery Repairman	158.3	19.4
AFQT Percentile	60.7	19.0

IV. Results

This chapter is organized into four sections. The first section describes qualification trends by gender for four ASVAB composites over eleven years. The four ASVAB composites are: Electronics, Basic Electronics and Electricity, Mechanical, and Machinery Repairman. For each of these composites, the data are first expressed in terms of the qualification rates by gender and, next, in terms of qualification rates by race and gender. The second section describes the percentage of authorized billets for pay grade E-3 (from the 1992 Enlisted Programmed Authorization or EPA) that qualified women could fill if the combat exclusion laws and policies that apply to women are removed. The third section presents a comparison of the ratings or occupations that female accessions entered in the years 1981 and 1992. This comparison first divides each year-group into those who could qualify for the Electronics composite and those who could not. A breakdown is then presented of the numbers of qualified women who selected a particular category of ratings. The fourth and final section provides a description of the 1992 female accessions who qualified for each ASVAB composite by the Recruiting Area from which they enlisted.

The qualification rates and trends discussed in this section are based on only those people who made a decision to

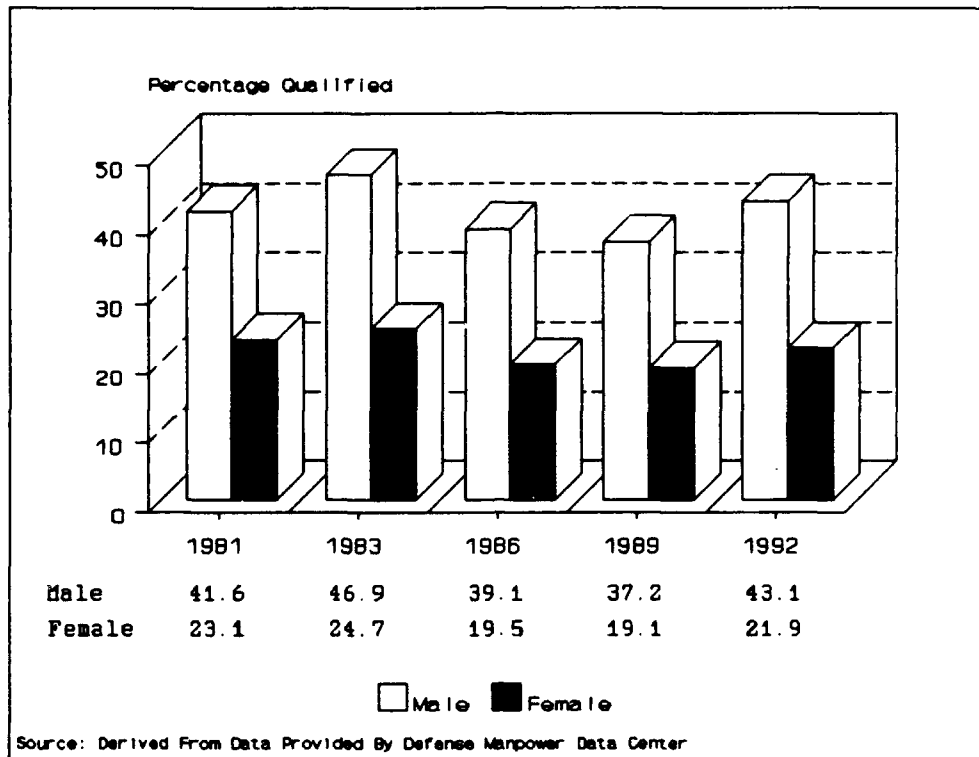
join the Navy. It is important to note, therefore, that any improvement or decline in the qualification rate of a particular group is directly linked to the Navy's success in attracting quality recruits from one year to the next, and these shifts do not necessarily reflect changes or trends in the general population.

A. Qualification Trends

1. Electronics Composite

Figure 1 shows the qualification trends that have occurred in the Electronics Composite with respect to gender over the past 11 years. The differences in qualification rates between male and female sailors have remained steady over this period, with men qualifying for this composite at roughly twice the percentage as women. Although the male-female ratio has remained fairly constant between 1981 and 1992, the proportion of women who qualified for this composite decreased by 1.2 percentage points (from 23.1 to 21.9) while the proportion of men who qualified increased by 1.6 percentage points (from 41.6 to 43.1). A statistical analysis of the 1981 and 1992 population proportions for women and men reveals that these changes are statistically significant²⁵. This trend

²⁵ A Z-test was conducted utilizing a hypothesis test for two population proportions for large independent samples. The results were significant at the .05 level for both the population of women and men.



**Figure 1. Electronics Composite:
Percentage Qualified Navy Recruits By Gender
and Selected Fiscal Year of Entry, 1981-1992**

in scores for women is consistent with a General Accounting Office (GAO) study that also examined the scoring trends of military recruits. The GAO study examined the AFQT and selected technical composite scores, including the Electronics composite, of military recruits from 1981 to 1989. The GAO study noted that "female scores improved dramatically from 1981 to 1983 but then flattened out, so that by the end of the decade they were lower than in any year since 1985."²⁶

²⁶ General Accounting Office (GAO) Report PEMD-91-4, "Military Training: Its Effectiveness for Technical Specialties is Unknown," October 1990, p. 20.

Figure 2 shows the Electronics Composite qualification trends for women by racial/ethnic group. Hispanic women exhibited the most improvement as their qualification rate increased by almost 8 percentage points over the 11-year period, closing the gap with their white counterparts, so that as of 1992 they lag behind by just 8 percent. Black women displayed a slight increase, with their qualification rate rising by more than 2 percentage points, while white women showed little improvement in their rate of qualification. As seen in Figure 2, there is a consistently large disparity

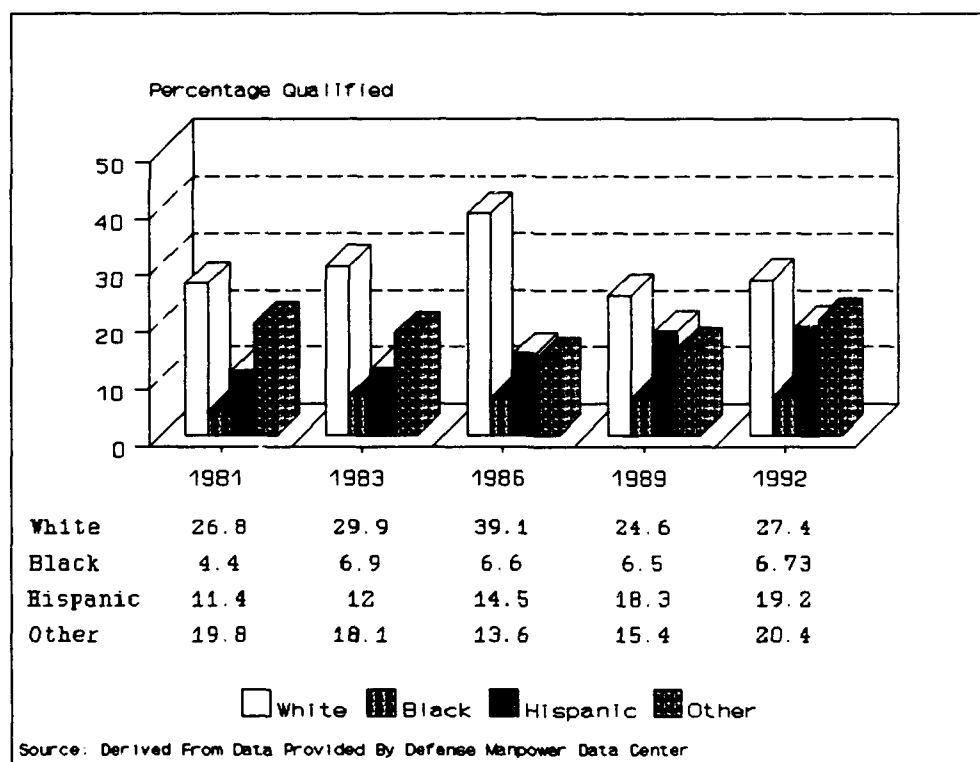


Figure 2. Electronics Composite: Percentage of Qualified Female Recruits in the Navy by Racial/Ethnic Group and Selected Fiscal Year of Entry, 1981-1992

between the qualification rates of black women and those of their white counterparts. The qualification rate of black women is generally 20 percentage points lower than the rate of white women, with variations over the separate years studied. This corresponds with previous research concerning racial/ethnic differences in qualification rates for technical occupations.²⁷ An inspection of the trend reveals that black women in the Navy have made little progress toward closing this gap since 1981. The Other category did not make any improvements or a declines in their qualification percentage relative to their white counterparts.

Figure 3 displays the Electronics composite qualification trends for male recruits in the Navy by racial/ethnic group. Hispanic Men, like their female counterparts (Figure 2), exhibit the largest increase in qualification, with the rate rising 13.5 percentage points between 1981 and 1992. Although the qualification rate for black men has also increased somewhat, the disparity between the qualification rates of black and white men remains large and has widened slightly since 1981. In 1981, white men had a qualification rate that was 32 percentage points higher than

²⁷ For example, Mark J. Eitelberg, Manpower for Military Occupations, 1988.

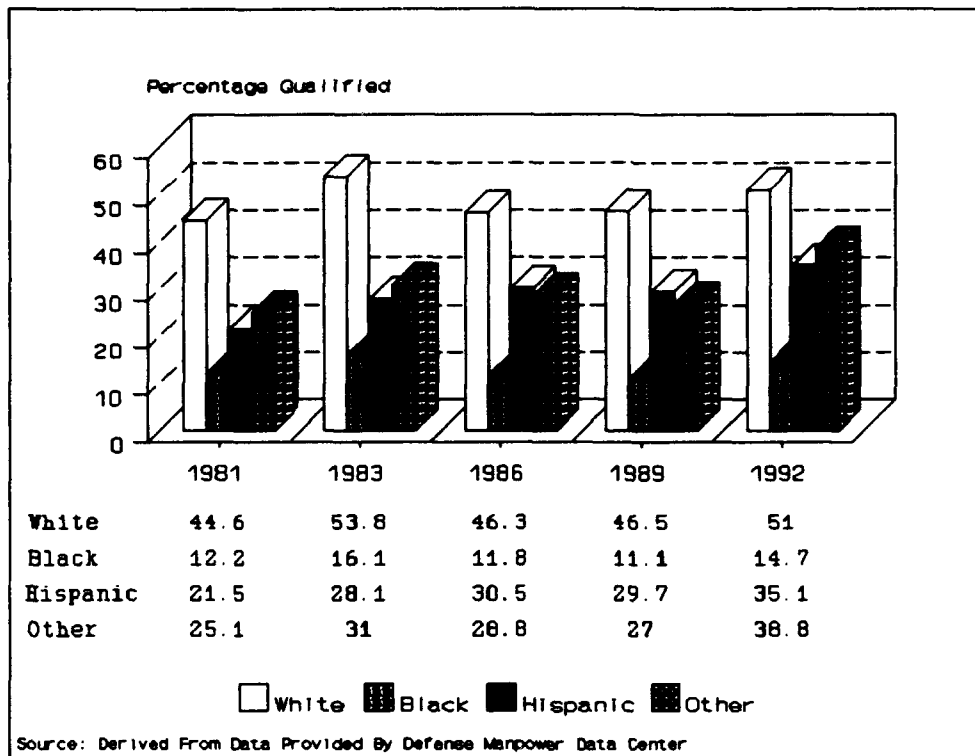
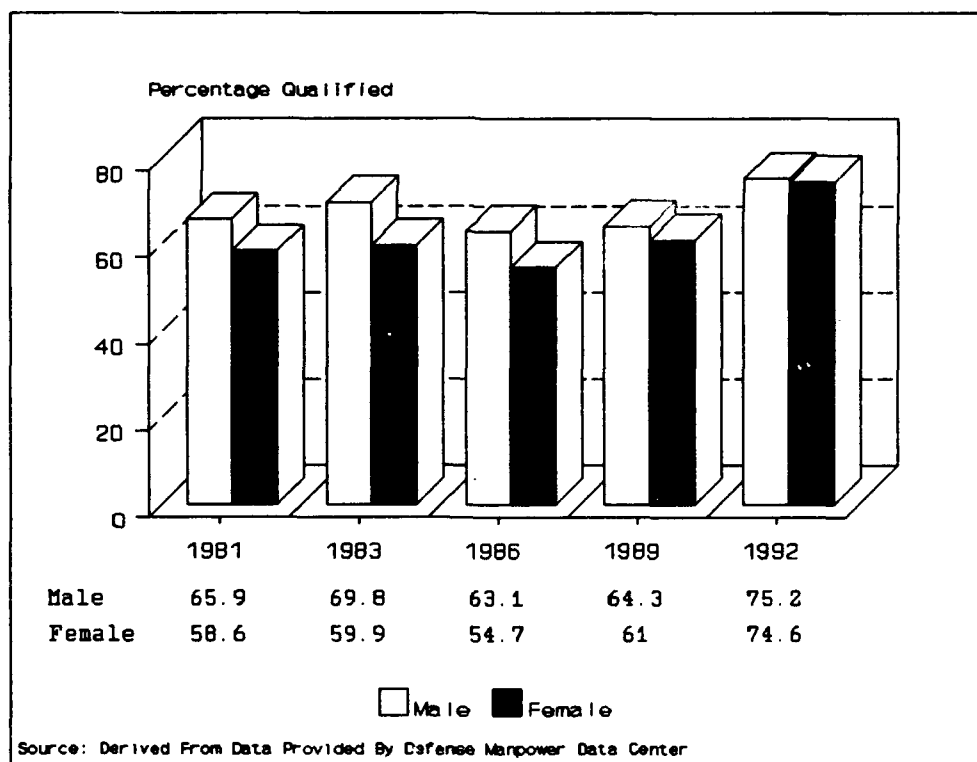


Figure 3. Electronics Composite: Percentage of Qualified Male Recruits in the Navy, by Racial/Ethnic Group, Selected Fiscal Year of Entry, 1981-1992

the rate for black men on this composite. With the exception of 1983, when the disparity between black and white men was 37 percentage points, the gap between the qualification rates of black and white men has increased by 1 percentage point during every three-year period measured. In 1992, the qualification rate for white men was 36 percentage points higher than that for their black counterparts.

2. Basic Electronics and Electricity Composite

Figure 4 shows the qualification trends of Navy recruits for the Basic Electronics and Electricity composite (B/EE) by gender over the past 11 years. This is the only ASVAB composite, of the four examined, in which the qualification rate of women improved during the study period. The qualification rate for women rose by more than 16 percentage points between 1981 and 1992. The B/EE composite is also the only one of the four studied here for which women qualify at nearly the same rate as men. One possible



**Figure 4. Basic Electronics and Electricity Composite:
Percentage of Qualified Navy Recruits by Gender,
Selected Fiscal Year of Entry, 1981-1992**

explanation for the improvement in the female qualification rate for this composite may relate to the fact that a large portion of the composite score concentrates on math skills. The B/EE Composite uses the Math Knowledge (counted twice), Arithmetic Reasoning, and General Science Subtests. Recent studies concerning gender differences in math performance have found that, although women's grades in a given math course are "about equal to or slightly higher than men's average grades,"²⁸ women tend to score slightly lower than their male counterparts on the math section of the Scholastic Aptitude Test (SAT).²⁹ This suggests that women would perform at nearly the same rate or just slightly lower than men on a math-dominated test such as the B\EE composite.

Figure 5 shows the Basic Electronics and Electricity composite trends for female Navy recruits by racial/ethnic group. As seen here, women in each of the racial/ethnic categories have made significant improvements since 1981. However, the qualification rate of black women in 1992 was about 16 percentage points lower than the rates of women in the other categories. At the same time, black women have made

²⁸ Brent Bridgeman, and Cathy Wendler, "Gender Differences in Predictors of College Mathematics Performance and in College Mathematics Course Grades" Journal of Educational Psychology, 1991, v. 83, p. 275.

²⁹ Howard Wainer and Linda Steinberg, "Sex Differences in Performance on the Mathematics Section of the Scholastic Aptitude Test: A Bidirectional Validity Study", Harvard Educational Review, 1992, v. 62-3, p. 323-335.

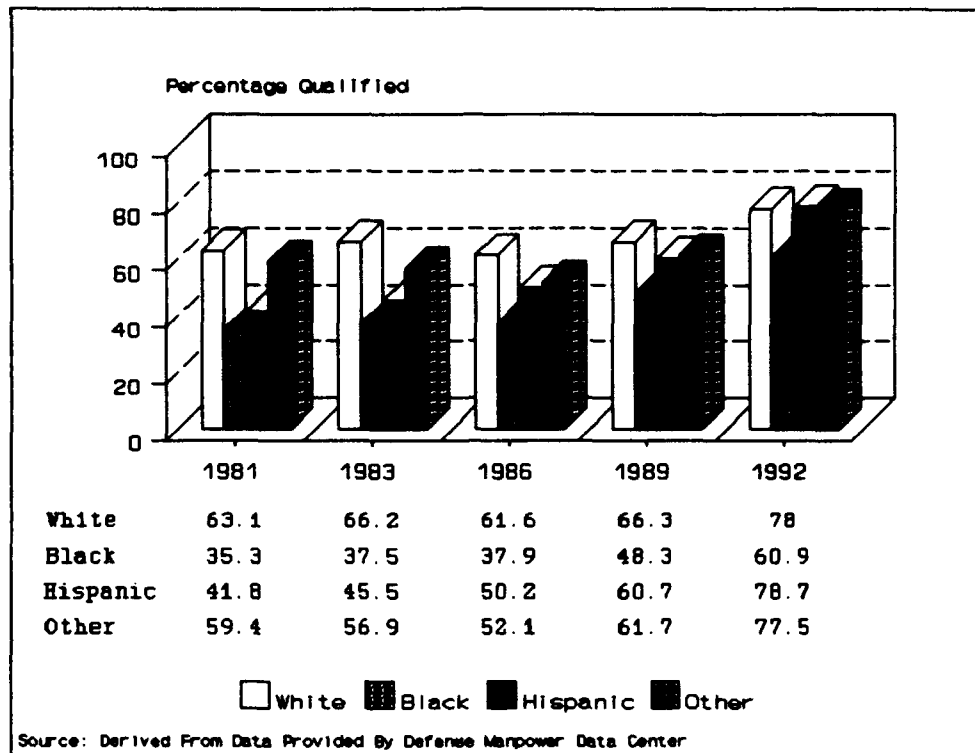


Figure 5. Basic Electronics and Electricity Composite: Percentage of Qualified Female Recruits in the Navy by Racial/Ethnic Group, Selected Fiscal Year of Entry, 1981-1992

significant gains; and, as of 1992, their qualification rate for this composite was 6 percentage points higher than the qualification rate of their male counterparts in the Navy. In addition, the qualification rate for Hispanic women was the highest of all racial/ethnic groups (78.7 percent), and rose by almost 37 percentage points between 1981 and 1992 (the largest increase of all groups).

Figure 6 shows the B/EE Composite qualification trends for men by racial/ethnic group. The qualification rates for

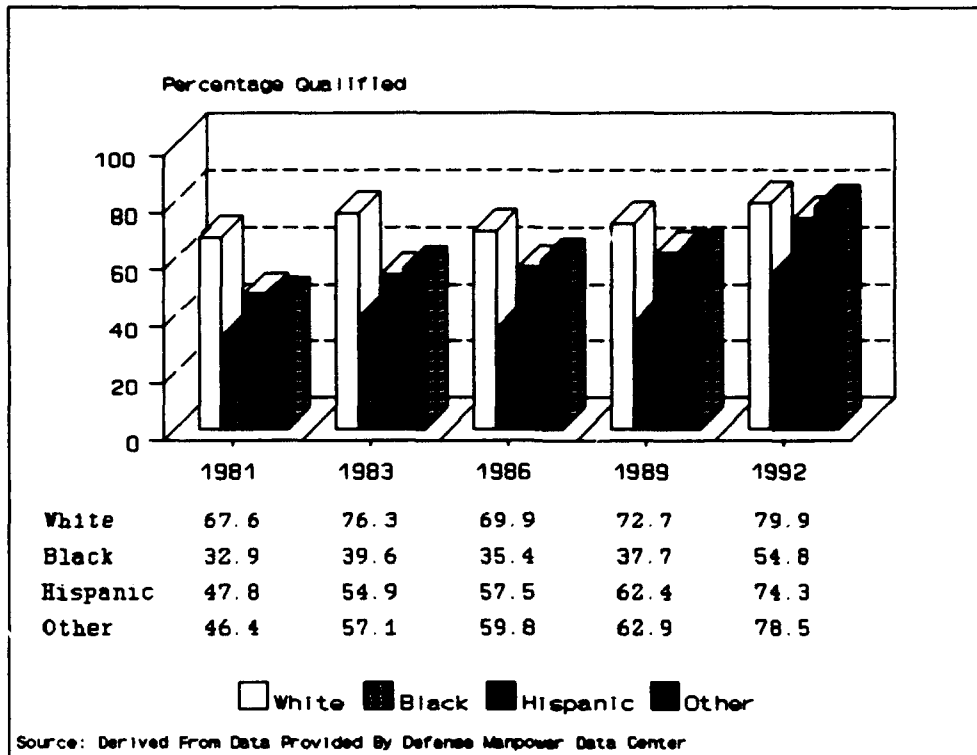
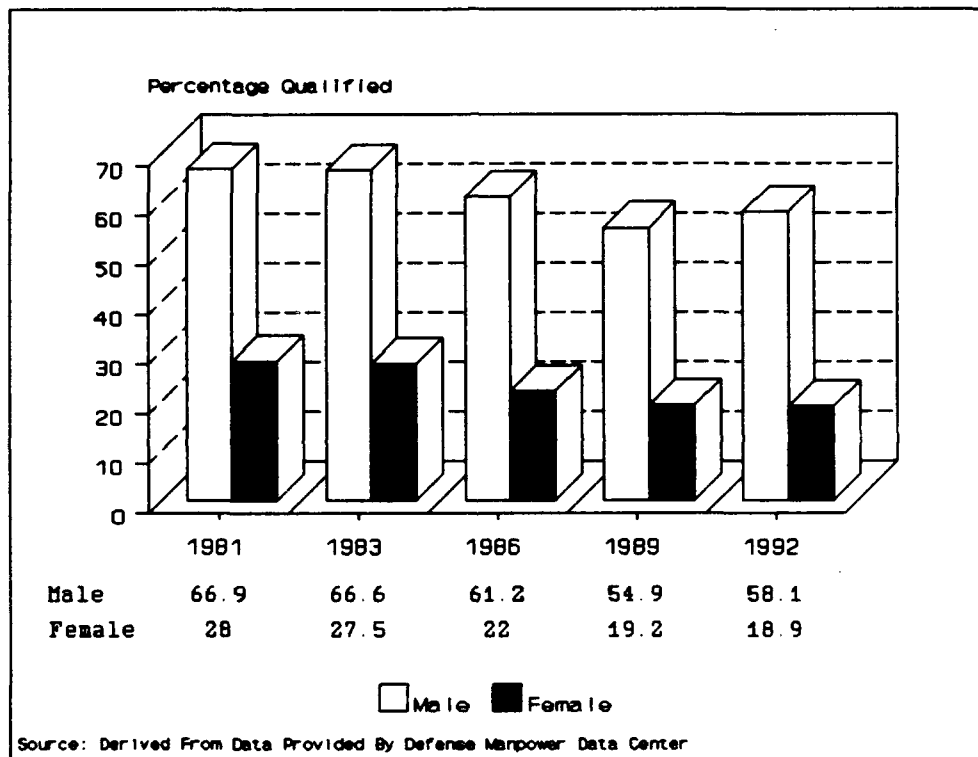


Figure 6. Basic Electronics and Electricity Composite: Percentage of Qualified Male Recruits in the Navy by Racial/Ethnic Group, Selected Fiscal Year of Entry, 1981-1992

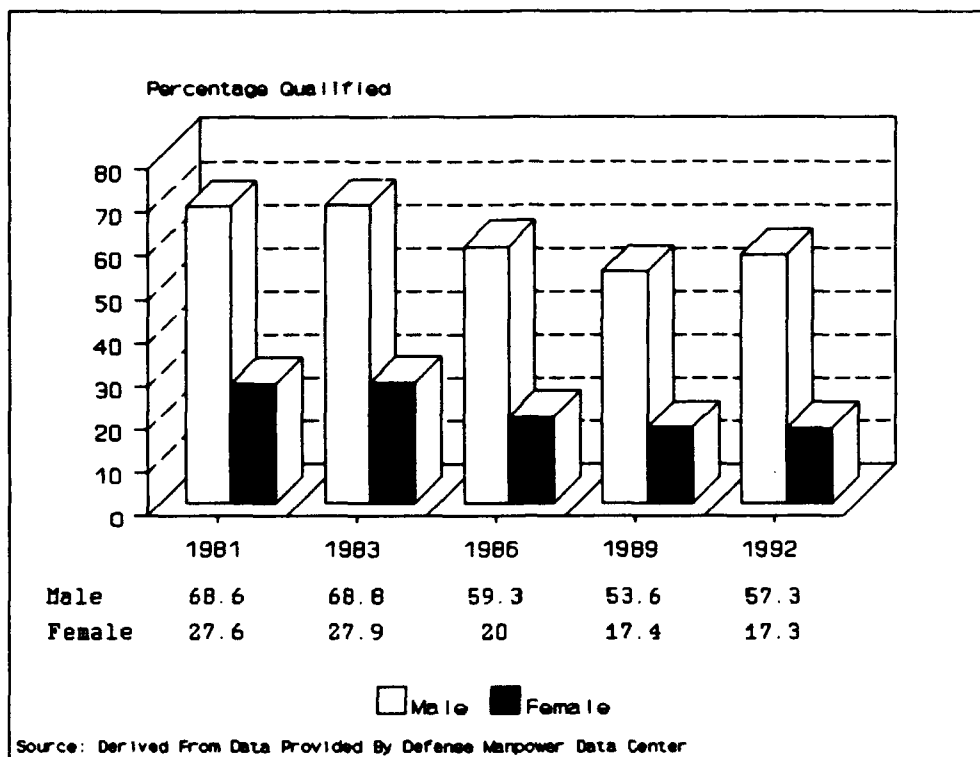
all groups of men improved considerably. Although white men exhibited the smallest increase between 1981 and 1992, about 80 percent qualify for this composite. As noted in Figure 4, the qualification rate for blacks tends to lag behind the rates for persons in other racial/ethnic groups. Still, the rate for blacks did increase by almost 22 percentage points over the 11-year period. Hispanic men also made a dramatic improvement, closing the qualification gap with their white counterparts to less than 6 percentage points in 1992, up from 20 percentage points in 1981.

3. Mechanical and Machinery Repairman Composites

Figures 7 and 8 display the qualification trends for the Mechanical and Machinery Repairman Composites by gender over the 1981 through 1992 period. For both of these



**Figure 7. Mechanical Composite:
Percentage of Qualified Navy Recruits by Gender,
Selected Fiscal Year of Entry, 1981-1992**

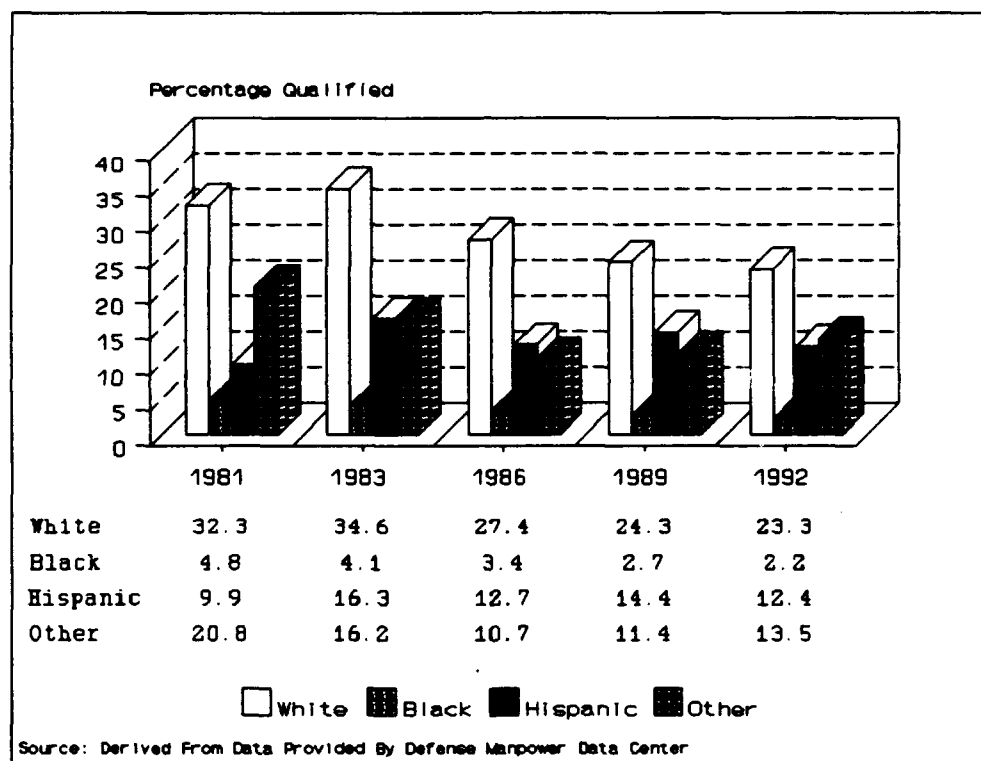


**Figure 8. Machinery Repairman Composite:
Percentage of Qualified Navy Recruits by Gender,
Selected Fiscal Year of Entry, 1981-1992**

composites, the qualification rates of men and women have decreased at almost the same rates. Men and women both tend to qualify at 9 percentage points less in 1992 than they did in 1981. One possible explanation for this drop in eligibility is that, over the past two decades, there has been a Nationwide decline in test scores of American Youth on technical subjects. This trend may be reflected on the Machinery Repairman composite which combines the Arithmetic Reasoning,

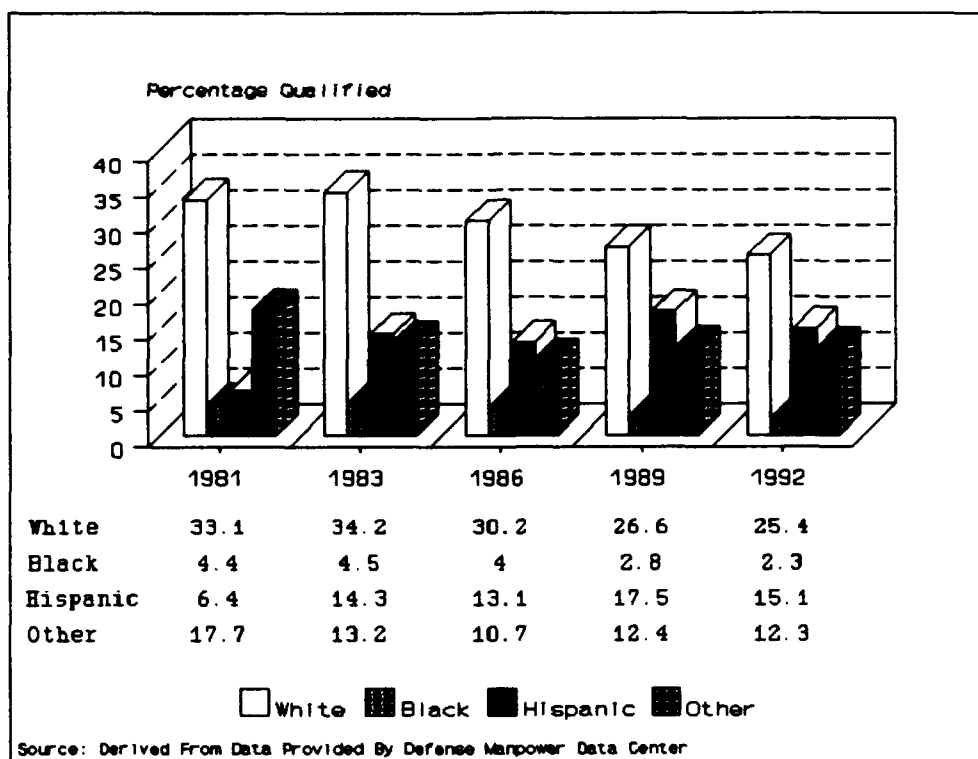
Mechanical Comprehension, and Auto Shop Information subtest³⁰. It may also be indicative of general slippage in the technical competence of Navy recruits, not readily apparent in AFQT scores from year to year. This trend is supported by the results of this thesis these since declines occurred in 3 of the 4 ASVAB composites examined (see Figures 1, 7, and 8).

Figures 9 and 10 show the qualification trends for women on the Mechanical and Machinery Repairman composites



**Figure 9. Mechanical Composite:
Percentage of Qualified Female Recruits in the Navy by
Racial/Ethnic Group, Selected Fiscal Year of Entry,
1981-1992**

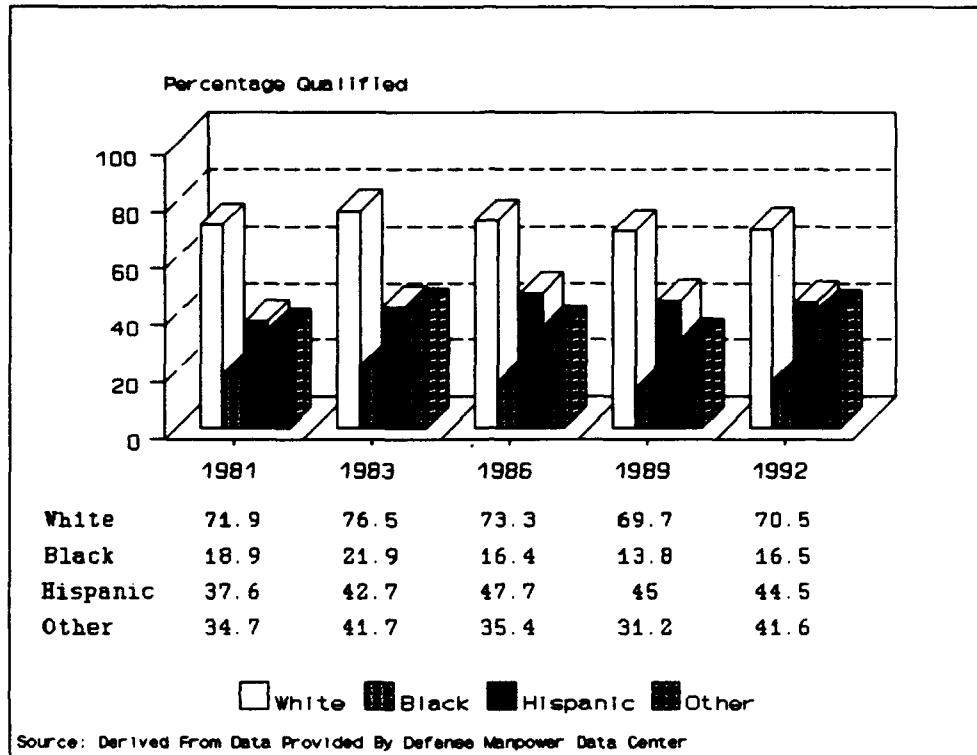
³⁰ Linda L. Kalford and Janice H. Laurence, "The Quality Queue and Defense Manpower", in Mark J. Eitelberg and Stephen L. Mehay, eds., Marching Towards the 21st Century, Westport, CT, Greenwood Press, In Press.



**Figure 10. Machinery Repairman Composite:
Percentage of Qualified Female Recruits in the Navy by
Racial/Ethnic Group, Selected Fiscal Year of Entry,
1981-1992**

over the 1981 through 1992 period by racial/ethnic group. As seen here, with the exception of Hispanic women, the qualification rates of women in all racial/ethnic groups have declined. Hispanic women are the only group to experience a consistent and significant increase on all four ASVAB composites. Black women qualify for these composites at significantly lower rates than women in other racial/ethnic groups. In 1992, less than 3 percent of black female recruits were found to be qualified for these two composites.

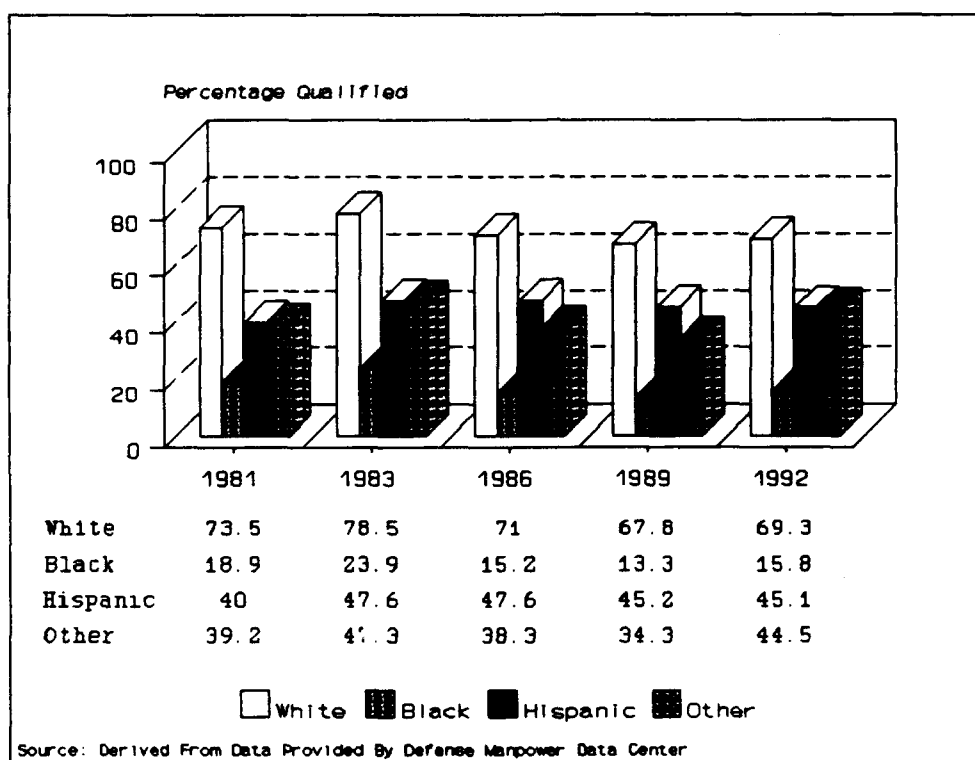
Figures 11 and 12 display the Mechanical and Machinery Repairman composites trends for men by racial/ethnic group



**Figure 11. Mechanical Composite:
Percentage of Qualified Male Recruits in the Navy by
Racial/Ethnic Group, Selected Fiscal Year of Entry,
1981-1992**

between 1981 and 1992. The qualification rates for black men and white men have declined at approximately the same rate with respect to both the Mechanical and Machinery Repairman composites. At the same time, the qualification rates for Hispanic men and "Others" have increased on both of these composites. This section has focused on the qualification

trends of Navy Recruits for four ASVAB composites over the past 11 years. However, the importance of these trends depends on how they relate to the Navy's requirements to fill billets. The next section discusses how many billets potentially qualified women could fill if current restrictions on assignments are removed.



**Figure 12. Machinery Repairman Composite:
Percentage of Qualified Male Recruits in the Navy by
Racial/Ethnic Group, Selected Fiscal Year of Entry,
1981-1992**

B. Qualified Women relative to Authorized Billets

This section examines the number of the Navy's authorized E-3 billets, for 1992, that are linked to the Electronics, Basic Electronics and Electricity, Mechanical, and Machinery Repairman composites. Estimates are made concerning the proportion of qualified women who could fill these billets, assuming that current combat exclusion policies and other restrictions are lifted. This proportion was calculated by first determining the number of qualified women for each ASVAB composite. Next, the number of authorized E-3 billets from the Enlisted Programmed Authorization (EPA) was determined. The EPA (dated 3 August 1992) summarizes the Military Personnel Navy (MPN) account for the end of fiscal 1992 and forecasts the projected MPN through fiscal 1997³¹.

Table 18 shows the percentage of Navy-authorized E-3 billets that qualified women could fill for each of the four ASVAB composites. As seen here, qualified women could fill 13.3 percent of the Navy's requirement for billets that use the Electronics Composite as a screen. This is the smallest percentage of billets that can be filled by women among the four composites in the study. Ratings that use the Electronics

³¹ Bureau of Naval Personnel (3 August 1992), Enlisted Programmed Authorizations Military Personnel Navy (MPN) for Fiscal Years 1992-1996, Department of the Navy, Washington, D.C.. It should be noted that these numbers are likely to change if end-strength totals are lowered under the defense downsizing.

TABLE 18.
NUMBER AND PERCENTAGE OF AUTHORIZED E3 BILLETS* QUALIFIED
FEMALE RECRUITS COULD FILL, BASED ON FOUR
ASVAB COMPOSITES, 1992

Composite	Number of Female Recruits Qualified For Each Composite		Number of Authorized Billets For Each Composite		Percentage of Billets Qualified Female Recruits Could Fill
Electronics	1,772	÷	13,293	=	13.3%
Basic Electronics & Electricity	6,037	÷	2,992	=	201.8%
Mechanical	1,528	÷	4,344	=	35.2%
Machinery Repairman	1,402	÷	1,840	=	76.2%

* Based On Enlisted Programmed Authorization (EPA), 3 Aug 1992
Bureau of Naval Personnel, Washington D.C.

composite are high-tech skills where the Navy tends to have the greatest need for qualified personnel. On the other hand, potentially qualified women could fill 201.8 percent of the billets that use the Basic Electronics and Electricity composite as a screen. However, The B/EE composite needs less than 3,000 billets filled each year. This means that there is an excess capacity of 3,045 potentially qualified women available for ratings linked to the B/EE composite.

In summary, the composite with the largest requirement for billets each year, Electronics, is where the lowest percentage of women qualify; and the composite with the greatest excess capacity of potentially qualified women, Basic Electronics and Electricity, has a relatively small number of billets to fill each year. The percentages shown in Table 18 would be adequate to place an equal distribution of qualified women into each of the four composites examined, relative to the total percentage of women in the Navy, if every women who qualifies under a particular composite would opt for an occupation using that ASVAB composite as a screen. Clearly, this is not a realistic scenario.

Tables 19 through 22 show the percentage of women who qualify for one composite and additionally qualify for the others. The fact that women can qualify for multiple composites means they have a choice when they select a rating. As seen in Table 19, women who qualify for the Electronics composite, where the Navy has the largest requirement to fill

billets, also qualify for the other composites at a relatively high rate. However, a high multiple qualification rate does not exist for all of the composites. For example, women who qualify for the B/EE composite (Table 20), where the Navy has the largest share of potentially qualified women, qualify for the other three composites at a rate of less than 30 percent. Tables 21 and 22 show the percentage of women who qualify for the Mechanical composite and Machinery Repairman composite, respectively, that also qualify for other composites. These women tend to qualify for other composites at a fairly high rate (between 64 and 99 percent); and they therefore have a number of choices when selecting an occupation.

TABLE 19.
PERCENTAGE OF WOMEN QUALIFYING FOR ELECTRONICS
COMPOSITE WHO ALSO QUALIFY FOR:

Basic Electronics & Electricity	Mechanical	Machinery Repairman
100%	54.9%	58.9%

TABLE 20.
PERCENTAGE OF WOMEN QUALIFYING FOR B/EE COMPOSITE
WHO ALSO QUALIFY FOR:

Electronics	Mechanical	Machinery Repairman
29.4%	24.0%	22.9%

TABLE 21.
PERCENTAGE OF WOMEN QUALIFYING FOR MECHANICAL COMPOSITE
WHO ALSO QUALIFY FOR:

Electronics	Basic Electronics & Electricity	Machinery Repairman
63.7%	94.8%	76.1%

TABLE 22.
PERCENTAGE OF WOMEN QUALIFYING FOR MACHINERY REPAIRMAN
COMPOSITE WHO ALSO QUALIFY FOR:

Electronics	Basic Electronics & Electricity	Mechanical
74.5%	98.6%	82.9%

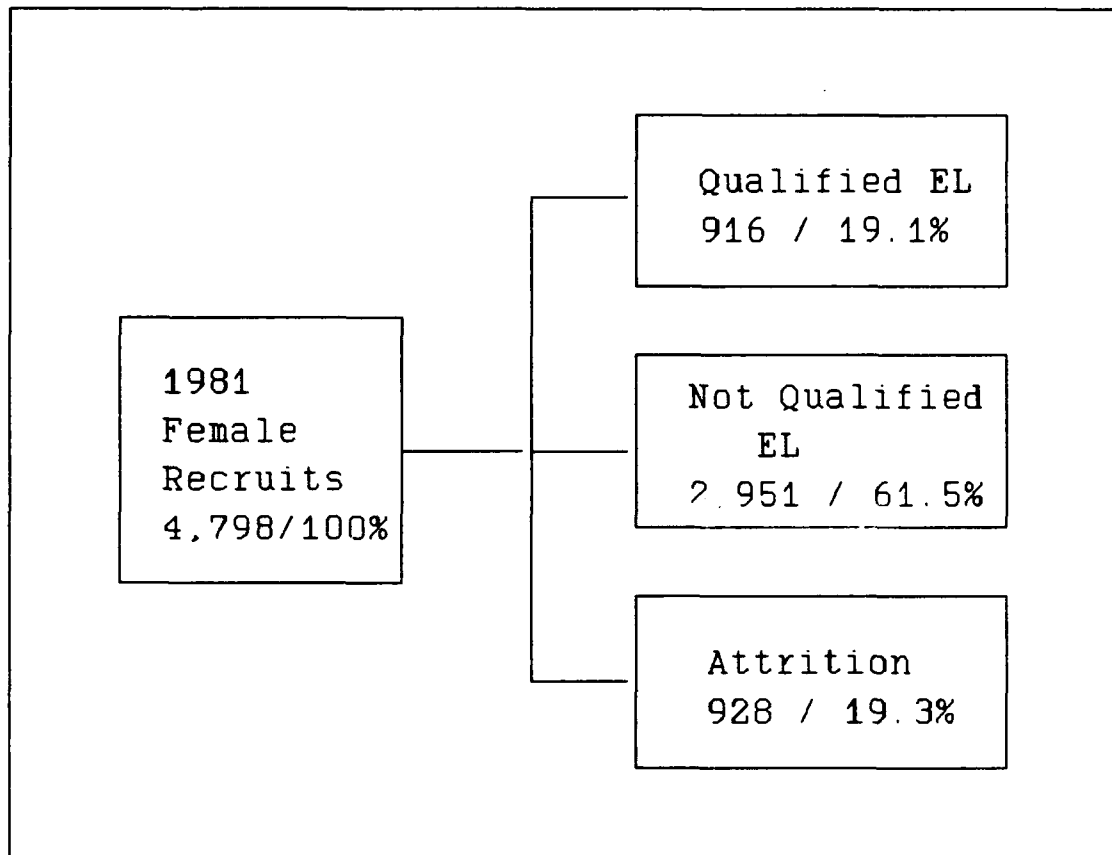
C. Comparison of Occupations Selected by Women in the Years 1981 and 1992

This section examines the percentage of women, in the years 1981 and 1992, who did or did not qualify for the Electronics composite. It also looks at the actual occupational choices of women who qualified for the Electronics composite. As pointed out in the previous section, a relatively large number of ratings are linked to the Electronics composite. This composite (of the four examined here) is also where qualified women are found to fill the smallest percentage of the overall Navy requirement for billets.

Figure 13 describes the qualification distribution for year-group 1981. The figure also shows the number of women who have left the Navy within one year of their enlistment. The one-year point was chosen because, by this time, most new sailors have concluded their pipeline training and are headed for their first command. For the purposes of this thesis, "pipeline training" is considered as the training required for a person to be given a primary occupation code.³² As seen in Figure 13, 916 women qualified for the Electronics composite, representing 19.3 percent of all female recruits for that year. The difference between this percentage and the percentage in Figure 1, where 21.9 percent of women qualified

³² For a description of occupation codes see, Occupation Conversion Manual, Office of the Assistant Secretary of Defense (Force Management and Personnel), DoD 1312.1-series.

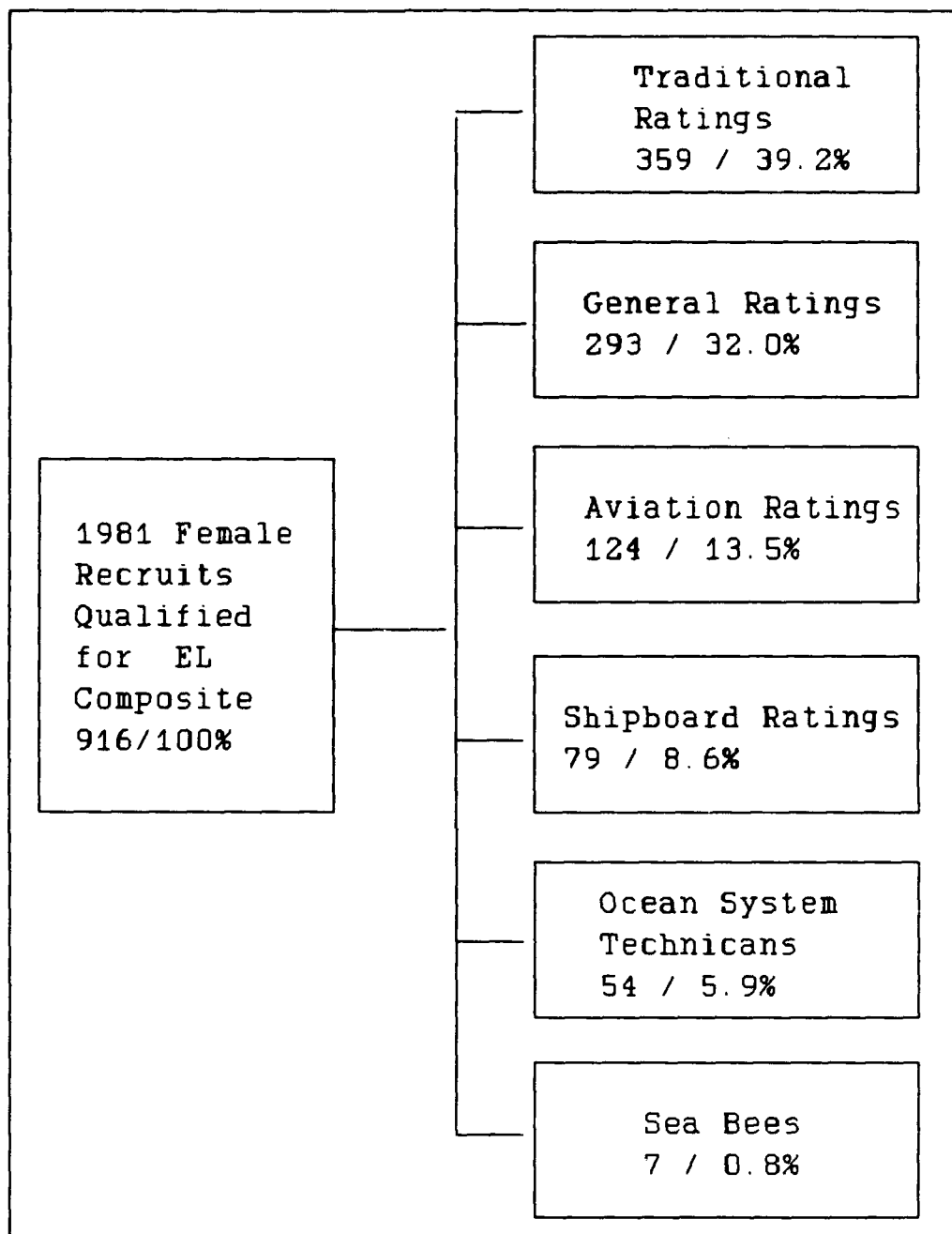
for the Electronics composite, is the result of personnel attrition.



**Figure 13. 1981 Female Recruits:
Distribution by Qualification and Attrition
for Electronics (EL) Composite**

Figure 14 shows the occupational categories selected by women in year-group 1981 who qualified for the Electronics composite and were still in the Navy. The categories were created by using the results of previous studies and the warfare area where the ratings are most commonly used. The Traditional Ratings category represents the 17 ratings that are considered traditional for women.³³ The General Ratings category includes those women who are considered not occupationally qualified, based on the Department of Defense Occupation Conversion Manual (for example, Seaman, Airman, Fireman, and Contructionman). The Aviation, Shipboard, and Sea Bee categories include occupations where the majority of work is accomplished in that respective warfare area. The Ocean Systems Technician category represents a rating that does not fall into any of the above groupings. As seen in Figure 14, the Traditional Ratings category had the highest percentage of female recruits for year-group 1981 (39.2 percent). The General Ratings category had the second-highest percentage of women (32.0 percent), followed by the Aviation and Shipboard Ratings (13.5 percent).

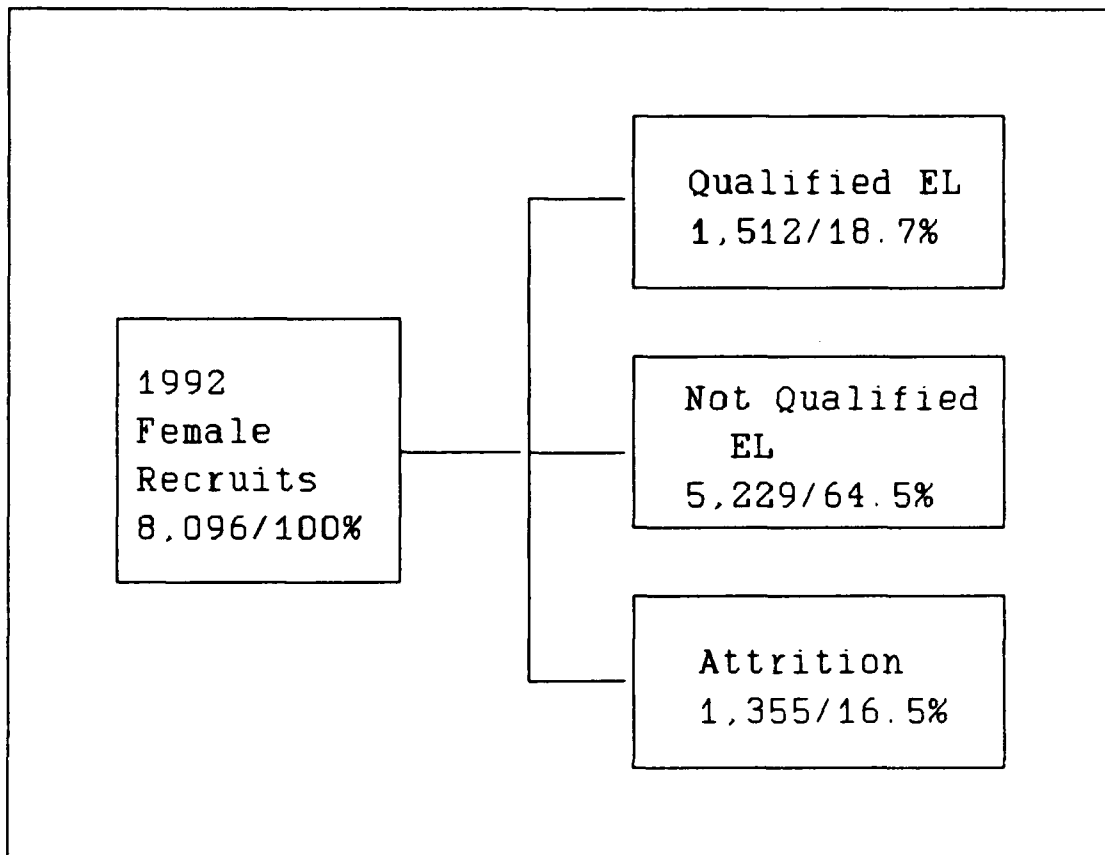
³³ Patricia J. Thomas, "Navy Women in Traditional and Nontraditional Jobs: A Comparison of Satisfaction, Attrition and Reenlistment", Technical Report 82-50, San Diego, CA, Navy Personnel Research and Development Center, 1982.



**Figure 14. Ratings Choices of Female Recruits
Qualifying for the Electronics (EL) Composite,
Fiscal 1981**

Figure 15 shows the qualification distribution for women in year-group 1992. The figure also shows the number of women who have left the Navy within one year of their enlistment, as previously discussed. As seen here, 1,512 women qualified for the Electronics composite, accounting for 19.0 percent of all female recruits for that year, virtually unchanged from the 1981 year-group. The difference between this percentage and that in Figure 1, where 21.9 percent of women qualified for the Electronics composite, can be attributed to personnel attrition.

Figure 16 displays the occupational categories selected by female recruits who qualified for the Electronics composite during fiscal 1992. The same categories that were used in Figure 14 are used for year-group 1992. As seen in Figure 16, several changes have occurred over the period since 1981. In 1992, the General Ratings category now receives 55.4 percent of all women who qualify for the Electronics composite, while the Traditional Ratings category receives only 17.7 percent. The Aviation, Shipboard Rating, and Sea Bee categories remained approximately the same, while the Ocean Systems Technician category received less than 1 percent of women who could qualify for the Electronics composite.



**Figure 15. 1992 Female Recruits:
Distribution by Qualification and Attrition for
Electronics (EL) Composite**

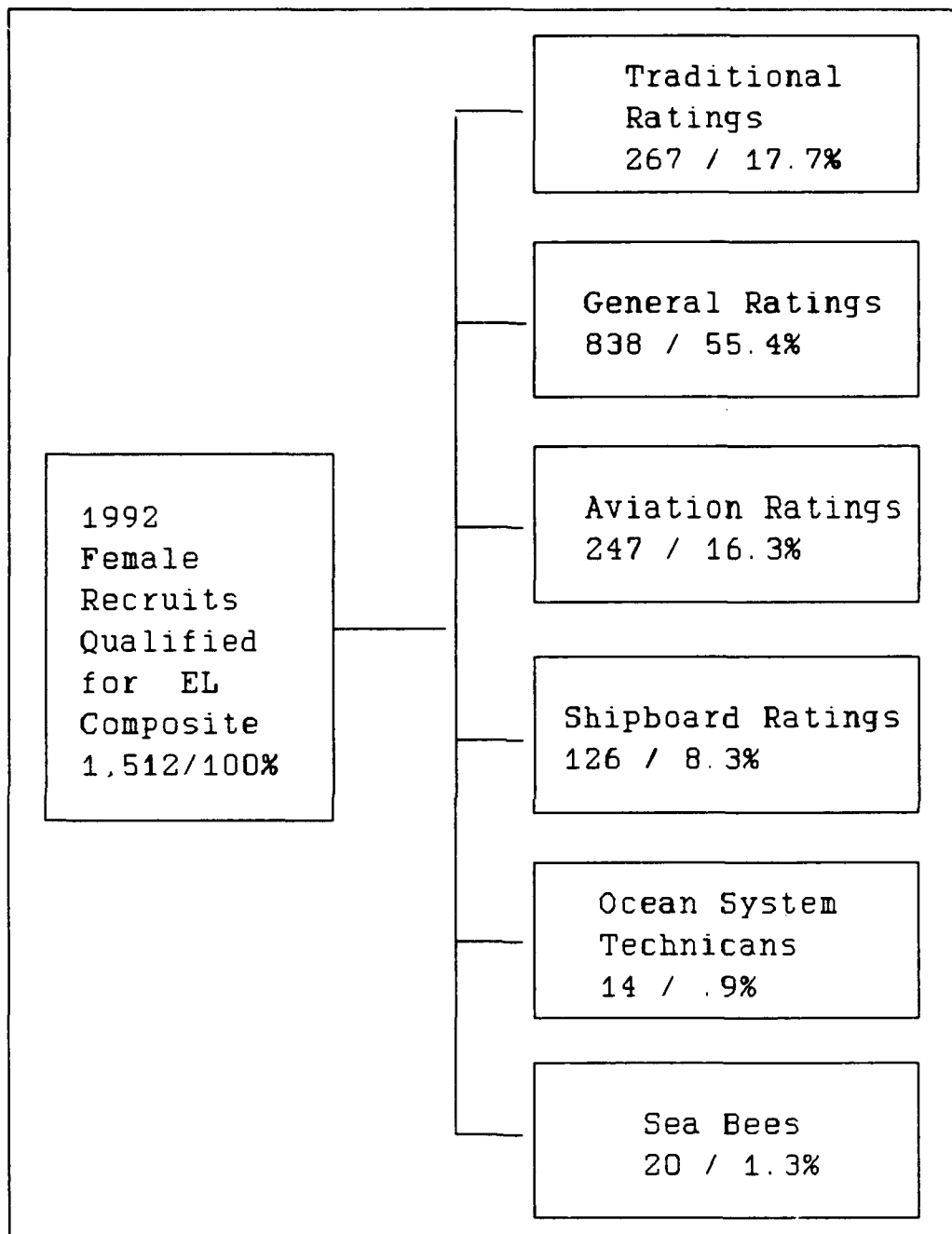


Figure 16. 1992 Ratings Choices of Female Recruits Qualifying for the Electronics (EL) Composite, Fiscal 1992

D. Qualification by Recruiting Area

This section examines the distribution of men and women who qualified for the Electronics, Basic Electronics and Electricity (B/EE), Mechanical, and Machinery Repairman composites by the Recruiting Area from which they enlisted. The Navy's Recruiting Areas are divided by geographic region of the country. Recruiting Area 1 represents the Northeast section of the United States; Recruiting Area 3 represents the South; Recruiting Area 5 represents the Midwest; Recruiting Area 7 represents the Southwest; and Recruiting Area Eight represents the West (Areas 2, 4, and 6 no longer exist.)

As seen in Figures 17 through 20, there is at most a 5 point difference between recruiting areas in the percentage of both the male and female recruits who qualified for the four composites mentioned above. A Chi-Square test was conducted on the data from each composite to determine if the percentage differences for each Recruiting Area were statistically significant from the proportion of recruits that was expected to qualify. Where there was a statistically significant difference, a large-sample hypothesis test for a population proportion was utilized to determine which individual Recruiting Areas were different for each ASVAB composite.

1. Electronics Composite

Figure 17 shows the percentages of recruits who qualified for the Electronic composite by gender and Recruiting Area. The Chi-Square test revealed that there was a significant difference between the expected and observed proportions of men who qualified for the composite³⁴. However, there was no difference in the expected and observed proportions of women who qualified for the Electronics composite. Next, a hypothesis test for a population proportion was conducted to determine which Recruiting Areas, for men,

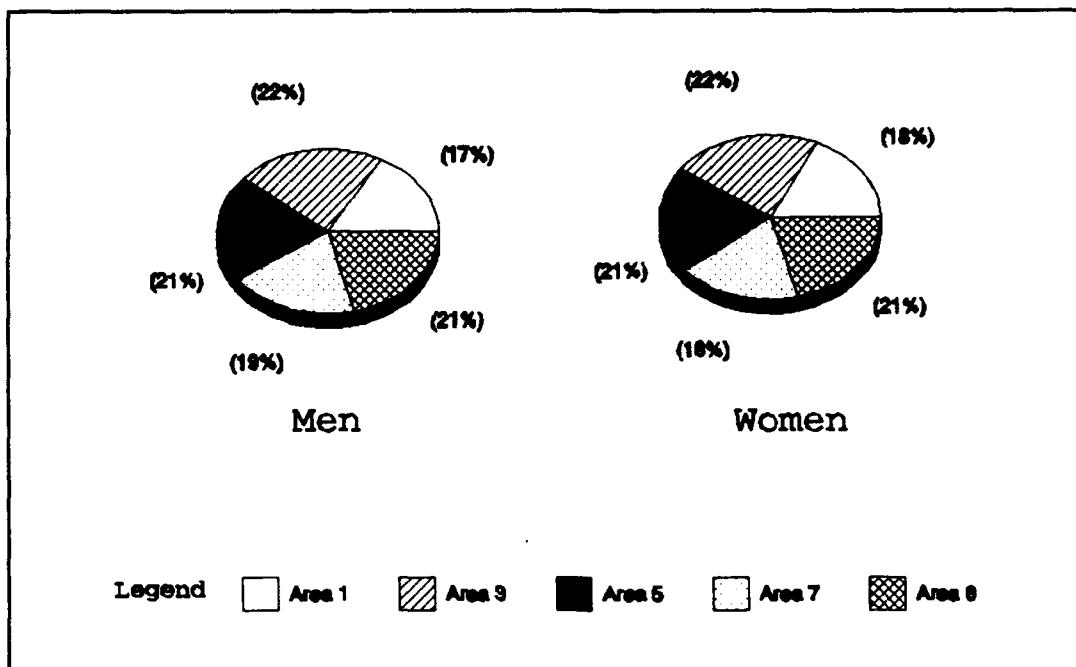


Figure 17. 1992 Navy Recruits Who Qualified for Electronics Composite by Gender and Recruiting Area

³⁴ The Chi-Square test with 5 degrees of freedom had a value of 93.9 and a probability value of less than 0.0001.

contributed to the significant difference. The Z-test revealed that Recruiting Areas 1 and 3 were responsible for the difference, while the percentages of recruits who qualified for the Electronics composite in Recruiting Areas 7, 5, and 8 were not significantly different than the expected percentage.³⁵ This means that Area 1 produced a significantly smaller percentage of qualifiers and Area 3 produced a significantly larger percentage of qualifiers than expected for both men and women.

2. Basic Electronics and Electricity (B/EE) Composite

Figure 18 shows the percentages of recruits who qualified for the Basic Electronics and Electricity composite by gender and Recruiting Area. The Chi-Square test revealed that there was a difference between the expected and observed proportions of both men and women who qualified for the composite³⁶. Next, a hypothesis test for a population proportion was conducted to determine which Recruiting Areas, for men and women, contributed to the significant difference. The Z-test revealed that, for both men and women, Recruiting Areas 1 and 7 were responsible for the difference, while the percentage of recruits who qualified for the B/EE composite

³⁵ The results were significant at the .005 level.

³⁶ For men, the Chi-Square test with 5 degrees of freedom had a value of 35.5 and a probability value of less than 0.0001. For women, the Chi-Square test with 5 degrees of freedom had a value of 71.9 and a probability value of less than 0.0001.

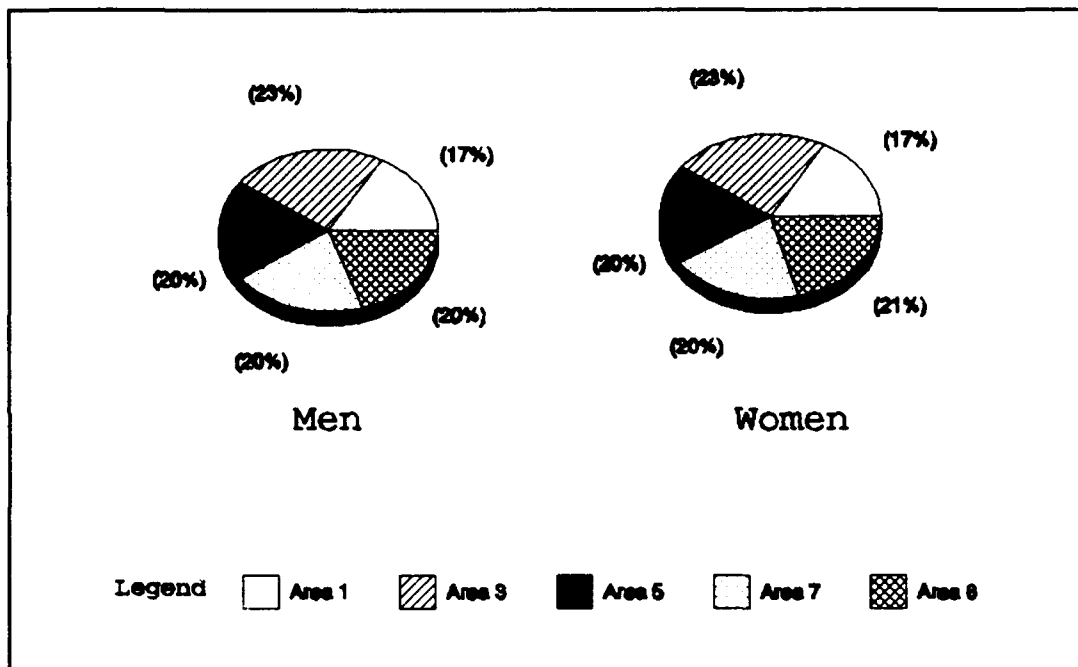


Figure 18. 1992 Navy Recruits Who Qualified for Basic Electronics and Electricity Composite by Gender and Recruiting Area

in Recruiting Areas 3, 5, and 8 were not significant.³⁷ This means that Area 1 produced a significantly less percentage of qualifiers and Area 3 produced a significantly larger percentage of qualifiers than expected for both men and women.

3. Mechanical Composite

Figure 19 shows the percentages of recruits who qualified for the Mechanical composite by gender and Recruiting Area. The Chi-Square test revealed that there was a difference between the expected and observed proportions of

³⁷ The results were significant at the .005 level.

both men and women who qualified for the composite³⁸. Next, a hypothesis test for a population proportion was conducted to determine which Recruiting Areas, for men, contributed to the significant difference. The Z-test revealed that, for men, Recruiting Areas 1, 3, 5, and 8 were responsible for the difference, and only area 7 did not contribute to the difference in the expected and observed proportions of recruits who qualified for the Mechanical composite.³⁹ This

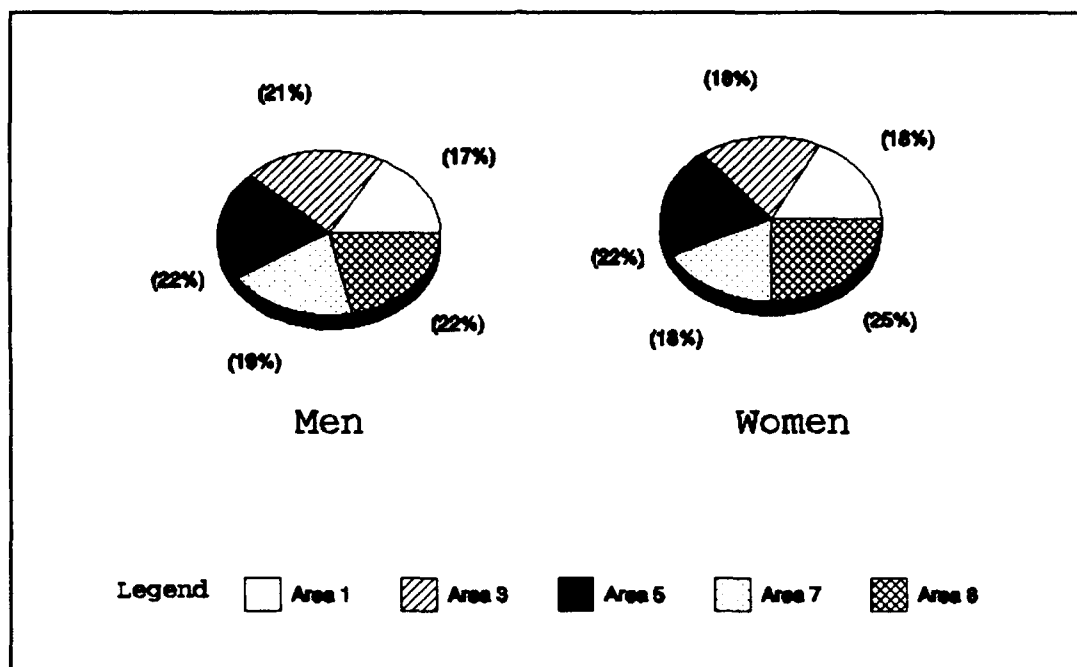


Figure 19. 1992 Navy Recruits Who Qualified for Mechanical Composite by Gender and Recruiting Area

³⁸ For men, the Chi-Square test with 5 degrees of freedom had a value of 445.2 and a probability value of less than 0.0001. For women, the Chi-Square test with 5 degrees of freedom had a value of 19.02 and a probability value of 0.002

³⁹ The results were significant at the .005 level.

means that for men Area 1 produced a significantly lower percentage of qualifiers than expected and Areas 3, 5, and 8 produced a significantly larger percentage of qualifiers than expected.

The Z-test conducted for women revealed that Recruiting Area 8 explained all the difference between the expected and observed proportions of women who qualified for the Mechanical Composite, and that there were no significant differences for the other Recruiting Areas.⁴⁰ This means that recruit Area 8 had a larger percentage of qualifiers than expected and all other Area produced the expected percentage of qualifiers.

4. Machinery Repairman Composite

Figure 20 shows the percentages of recruits who qualified for the Machinery Repairman composite by gender and Recruiting Area. The Chi-Square test revealed that there was a difference between the expected and observed proportions of both men and women who qualified for the composite⁴¹. Next, a hypothesis test for a population proportion was conducted to determine which Recruiting Areas, for men, contributed to the significant difference. The Z-test revealed that for men

⁴⁰ The results were significant at the .005 level.

⁴¹ For men, the Chi-Square test with 5 degrees of freedom had a value of 379.1 and a probability value of less than 0.0001. For women the Chi-Square test with 5 degrees of freedom had a value of 14.2 and a probability value of 0.014.

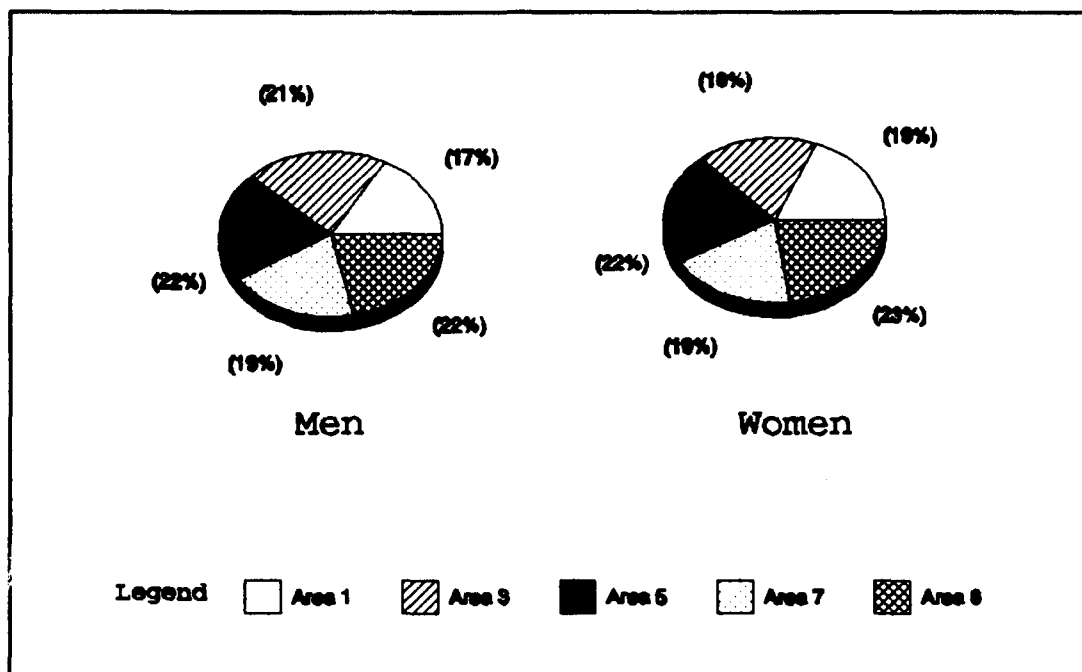


Figure 20. 1992 Navy Recruits Who Qualified for Machinery Repairman Composite by Gender and Recruiting Area

Recruiting Areas 1, 5, and 8 were responsible for the difference, and Area 3 and 7 did not contribute to the difference in the expected and observed proportions of male recruits who qualified for the Machinery Repairman composite.⁴² This means that, for men, Recruit Area 1 has a smaller percentage of qualifiers and recruit Areas 5 and 8 had a larger percentage of qualifiers than expected.

The Z-test conducted for women revealed that Recruiting Area 8 explained all the difference between the expected and observed proportions of women who qualified for the Mechanical composite, and that there were no significant

⁴² The results were significant at the .005 level.

differences for the other Recruiting Areas. ⁴³ This means that, for women, Recruiting Area 8 had a larger percentage of qualifiers than expected.

⁴³ The results were significant at the .005 level.

V. Summary, Conclusions, and Recommendations

This chapter briefly summarizes the study and presents the conclusions drawn from the results. It also offers some recommendations and suggests areas for further research.

A. Summary and Conclusions

The first part of the study examined the qualification trends of Navy recruits from 1981 through 1992 by gender and racial/ethnic group. Several interesting trends are apparent. First, women have not improved their qualification rate, relative to men, for three of the four composites examined. The only exception to this trend is the Basic Electronics and Electricity composite, where female recruits now qualify at almost the same rate as their male counterparts. The largest declines, approximately 10 percentage points, in female qualification rates occurred in the Mechanical and Machinery Repairman composites. However, the qualification rate of men also declined by approximately 10 percentage points for these composites. This means that the ratio of women to men who qualified for the Mechanical and Machinery Repairman composites remained stable at about two men qualifying for every one qualified women. For the Electronics composite, the qualification rates for women declined by 1.2 percentage points, while the qualification rate for men improved by

almost an equal amount. Although this seems like a small change, it may have considerable consequences, since the Electronics composite is where the Navy has the greatest annual requirement for qualified personnel. The fact that the Navy has so many billets to fill in the Electronics area --coupled with the fact that the women who qualified for the Electronics composite also qualified for other composites at a fairly high rate--suggests that the Navy may have difficulty in achieving a representative distribution of women in nontraditional occupations that use the Electronics composite as a screen.

The examination of qualification trends by racial/ethnic group indicates that Hispanic men and women were the only groups to have consistent and across-the-board improvements among the four ASVAB composites selected for study here.

Another area of interest involved the distribution of women who qualified for the Electronics composite. The study found that, of the women who qualify for the Electronics composite, more than half go to the fleet as a general duty Seaman, Airman, or Fireman rather than to technical fields or electronics-related occupations that are currently opened to women. This finding is disturbing, given the large number of electronics billets and the fact the only a small percentage of women qualify for the Electronics composite.

A final area of interest was the distribution of women who qualified for the four ASVAB composites by their Recruiting

Area. This section found that, for the Electronics and the Basic Electronics and Electricity composites, Recruiting Area 3 (South) had a significantly larger proportion of qualifiers than in Recruiting Area 1 (Northeast). The percentages of qualification for these two Recruiting Areas is contrary to the findings of other studies, which show that the Northeast has a relatively larger proportion of young people qualified for technical skills than in the South⁴⁴.

The results of this study suggest that little or no improvements have occurred in the qualification of female recruits for nontraditional Navy occupations over the 1981 through 1992 period. This finding, coupled with the results of other studies on the propensity of women to select nontraditional occupations, leads to the conclusion that the entry of women into previously-restricted, nontraditional ratings will probably be a slow process. To improve the numbers of women who enter nontraditional ratings, the Navy must establish programs to improve the qualification rates and interest of women in these areas.

B. Recommendations

This study provides a preliminary analysis of the qualification trends of women for a selected group of the Navy's nontraditional occupations. Further research into this

⁴⁴ See Mark Eitelberg, Manpower for Military Occupations, 1988.

area is required to determine if the findings in this study hold true for all ten of the ASVAB composites used by the Navy.

The task of this study was principally exploratory and descriptive in nature. Further research is warranted to explain the findings and trends discussed in this thesis. For example, an in-depth analysis of the propensity of women to select nontraditional occupations is needed to validate the distributions discussed in Section B of Chapter IV. Another area that warrants further research concerns the reasons why Hispanic men and women have shown such consistent and significant improvement in all four ASVAB composites, while other racial/ethnic groups have not. A final area for further investigation is the general decline in the percentages of men and women who qualify for the Electronics and other technical composites, considering that recruit scores on the AFQT have generally improved over the same period.

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